(See also UK National Archives ref. HO 225/42 by George R. Stanbury)

NOTE: the author of this report, UK government physicist and Principal Scientific Officer George Reginald Stanbury, OBE (25 Dec 1903 - 20 Nov 1973), attended the underwater nuclear test Operation Hurricane at Monte Bello to assess civil defence effects including fallout, on 3 October 1952 together with Frank H. Pavry (who had surveyed Hiroshima and Nagasaki in 1945 for UK civil defence). His simplified fallout pattern for harbour "Pearl harbour" style attacks is based on the Operation Hurricane fallout data, but at a lower secrecy classification for civil defence use.

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Assumed effects of two atomic bomb explosions in shallow water off the port of Liverpool

Prepared for a Civil Defence Exercise

by

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1 The assumed attacks

Two extreme but possible types of attack are considered -

(1) a sabotage daylight attack before a declaration of war and

(2) a warned night attack after a declaration of war

The first could be achieved by the delayed-action firing of an atomic bomb brought in by sea and laid on the river bed. There would be no evacuation, and many people would be out of doors, the worst time of day being the lunch hour when it is assumed that 20% would be in the open.

The second could be an airborne attack, but with 5 minutes warning everyone would be under cover. Priority evacuation (30%) would have been carried out.

Two positions for the explosion are considered for each of the assumed types of attack.

No.1 Bomb Midway between Gladstone and Canada Dock gates and 200 yards off shore. This produces the maximum damage to, and dislocation of, the main dock area.

No.2 Bomb Opposite the middle of Princes Pier and 200 yards off shore. This produces the maximum number of casualties due to fall-out.

Depth of explosion

About 10 feet below the surface of the water.

Power of weapon

20 kilotons - a nominal bomb.

Wind and weather

A mean surface wind of 10 m.p.h. from a direction 15° N of W. (N.B. the wind is in this quarter for about half the year). Clear dry weather.

Tide

Half flood tide at springs.

2 Blast damage to buildings

For a 1000 ft. air burst full details of the estimated effects on different types of structure are given in Table 1 of the C.D. Training Branch memorandum on "The Estimation of the Effects of Atomic Bomb Attacks on Cities". For this exercise the ranges given in this Table are reduced to allow for the energy absorbed in the water. If we consider a pressure of 10 p.s.i. - a pressure at which the majority of non-framed buildings would be destroyed - then the range would be 15% less for a ground burst than for a burst at 1000 ft. In this case we are considering an explosion under 10 ft. of water which would produce a further small reduction. At Bikini a similar bomb

exploded at a depth of 90 ft. in 200 ft. of water yielded a range for this pressure only 60% of that for a ground burst. Since we are considering a depth of burst of only 10 ft. we cannot expect a reduction on this account of more than about 5% giving a total reduction in range from the 1000 ft. air burst of about 20%.

For the destruction of steel or concrete framed buildings, where peak overpressures of 30 to 40 p.s.i. are required, the advantage of the 1000 ft. air burst is slightly more pronounced than at 10 p.s.i. and we might expect an overall reduction in range of 25% for such buildings.

When we consider the extent of blast damage, it must be realised that more than half the effect of the blast is wasted over water on the Birkenhead and Wallasey side and that this would not apply to such ports as Clydebank or London where the rivers are much narrower. Even in the Liverpool direction the first 200 yards is over water.

3 Fires

With a shallow-water explosion there would be little risk of fire from direct ignition by heat flash which would be largely absorbed by the water and mud and other debris thrown up by the explosion. There would probably, however, be two or three hundred "secondary" fires resulting from blast damage to buildings, and an unpredictable (though probably small) number of fires started by hot pieces of metal if the explosion had taken place in a ship.

Most of the fires would be in the zone beyond the range of total destruction of buildings by blast, and would therefore extend outwards from about ½ mile to 1½ miles.

This would not be an overwhelming fire situation as long as there was access for fire fighting, but heavy contamination by radioactive fall-out might prevent access for some considerable time (see paragraph 9). Many fires would burn themselves out, but some would spread to neighbouring buildings and eventually involve large blocks, but there is no evidence in the reports of the British Bombing Survey Unit or the United States Strategic Bombing Survey that this would occur to any pronounced extent in European cities. Unless a fire storm occurred it was usually found that the number of buildings destroyed by fire was never more than twice the number actually set alight by bombs.

4 Lock gates and dock facilities

Bomb No.1

The lock gates of Gladstone and Canada Docks at a range of about 750 yards would be damaged by blast, but would probably remain workable. It is not considered that water shock would contribute to the damage at this distance. It is unlikely that there would be any serious loss of water. All the gates in the adjacent Gladstone - Hornby lock, and the gate dividing Alexandra and Langton Docks at 300 yards would probably be destroyed.

The impounding station and equipment (near the outer entrance gate) would be destroyed.

The quay immediately opposite the explosion is about 200 ft. across and 44 ft. above the river bed. It has gravity walls on either side and is filled in. The top of the quay is -

25 ft. above mean tide level

11 ft. 5 in. above average high water

8 ft. above extreme equinoctial springs.

This quay would not be damaged by the blast and it is unlikely that it would be seriously affected by underwater or ground shock, although there is little experimental evidence on this point.

A 10 ft. wave at the shore line might possibly be expected from the explosion and although this would not cause flooding of the docks it might contribute to the damage to the dock gates.

In general it is considered that these main river-side quays would stand up to the stresses imposed upon them.

Bomb No. 2

With this bomb it would be the Princes and Albert Dock gates which would receive heavy damage, though the inner gates might still remain workable. The landing stage and approach bridges would be largely destroyed. The lock of Alfred Dock on the Birkenhead side 1000 yards away would not be seriously affected by the blast or the wave.

The Mersey Tunnel, being only 500 yards from the explosion at its nearest point could conceivably be fractured and might be expected to flood. This would certainly have happended if the position of the explosion had been chosen to be 200 yards nearer, and would probably not have happended if it had been 200 yards further away.

5 Shipping

The most recent studies of the results of the Bikini tests by the Directorate of Naval Construction give the following categories of damage to merchant ships for different ranges from a medium height air burst atomic bomb.

Up to 750 yd.	Sunk
Up to 1000 "	Seriously damaged; unable to steam.
Up to 2000 "	Varying degrees of damage but probably able to steam.

The ranges are different for an underwater explosion, but in this exercise, ships in dock would only be subject to the air blast. For the pressure required to do heavy damage to ship structures it has already been noted that the range from a shallow underwater burst would be about 25% less than for a medium air burst. It should also be borne in mind that a ship is much less vulnerable to air blast when it is head-on than when it is side-on, and the disposition of the north-end docks in Liverpool is fortunately such that the majority of ships would be head on to the explosion. It is therefore suggested that the following ranges should be adopted for the different categories of damage for this exercise.

Up to 500 yd.	Sunk
Up to 750 "	Seriously damaged; unable to steam
Up to 1500 "	Varying degrees of damage but probably able to steam
Beyond 1500 yd.	Undamaged

6 Transit sheds

Bomb No. 1

The 3-storey reinforced concrete transit sheds in Gladstone Dock, being mostly 3/4 miles from ground zero would be relatively undamaged.

All other sheds in this dock and in Canada Dock to the south at about the same distance, being mostly of old construction with tall load-bearing brick walls, would be damaged - main walls cracked etc. - but there would only be minor demolition.

In Hornby, Alexandra, Langton and Borcklebank Docks, the damage to transit sheds would be more serious since they are all within $\frac{1}{2}$ mile of the explosion. Much structural debris, including dock-side cranes, would litter the whole

area and a good deal of this would fall into the docks themselves where it would be a particular cause of annoyance.

Severe damage to corrugated iron roofing would occur as far as 1¼ miles from the explosion.

The overhead railway would be mostly outside the range of complete destruction, but at its nearest point (½ mile) there would probably be a good deal of local collapse and a through service would be impossible.

Bomb No.2

With this bomb the docks mostly affected would be Trafalgar, Victoria, and Princes to the north, and Albert, Salthouse, King's and Wapping to the south. The buildings in Princes Dock would be completely demolished and those in Trafalgar, Victoria, Albert and Salthouse would be largely destroyed.

7 Approach roads

Bomb No.1

The roads in Bootle in the area immediately behind the docks within about ¾ mile of the explosion would probably be impassable to wheeled traffic since they would be covered with debris of varying depths. Beyond this the extent of the debris would tail off rapidly to a layer of tiles, broken glass, chimneys etc. Wide roads running radially from ground zero would be least affected.

Bomb No.2

With this position, the docks along the river are very limited in depth, being backed by a highly congested commercial area which would be completely destroyed and would block all access roads within rather over ½ mile of the explosion, taking in the Exchange Station.

8 The initial nuclear radiation or "gamma flash"

With this shallow water explosion it is possible that some of the initial nuclear radiation would be absorbed at the source. Moreover with such a low burst most people in the open would be shielded from the direct beam of gamma radiation by buildings, although with such a low burst they would still receive some dose from gamma radiation scattered in the air and from buildings. It is assumed quite arbitrarily that these two effects combined would reduce the average gamma flash dose at any range in the open by 50%.

With regard to people in houses it is reasonable to assume that under these conditions there would be no fatal casualties from the gamma flash alone. In the first 1000 ft. the fatal casualties due to blast damage alone would be 100%, and from 1000 ft. to 2000 ft. they would be 80%. At distances of this order and greater the shielding against gamma radiation from a burst in the water would be considerable. Moreover with such a burst there might be a tendency for the energy of the radiation to be more degraded than from an air burst and this would further reduce its penetrating power.

The detailed assessment of casualties is dealt with in paragraphs 12, 13 and 14.

9 Residual radioactive contamination on land

The contamination pattern suggested in CD/SA.42 and reproduced at Figure 1 is assumed. Dose rate contours are given in roentgens per hour (r/hr) at 1 hour after the explosion since this is the most convenient time for calculation purposes. Deposition would however probably be almost complete in 10 minutes and it will be assumed therefore that contamination is effective from 5 minutes onwards. It must be remembered however that people in the open at the time of the explosion would also receive the initial nuclear radiation (see para: 8).

The contamination might be visible as splashes and blobs over the streets and on the walls of buildings, but this could not be relied on, and the fallout might be indistinguishable from ordinary dust; in any case radiac instruments would have to be used for assessing the degree of contamination.

If the contamination remained undisturbed its radioactivity would decay according to the well-known $T^{-1.2}$ law for mixed fission products, and the dose which would be accumulated between any two times could then be calculated. The maximum dose which could be accumulated in any one area would be what is known as "the infinity dose" i.e. the dose which would be received during continual exposure in the area from a given time T onwards. This is an easy figure to calculate since it is equal to:

5 x T x dose rate at time T

Thus on the 100 r/hr at 1 hr contour, the infinity dose from 1 hour onwards would be 500 r.

If we take the dose rate at one hour to be d then the dose rates at other times and the infinity doses from those times onwards are as given in Table 1. This table, or a curve based on it, would be necessary for the conversion of survey readings at different times to readings on a common time basis.

TABLE 1

Time after explosion (T)	Dose rate (r/hr)	Infinity dose from T (r)
5 min.	19.7 d	8.2 d
7 min.	13.2 d	7.7 d
10 min.	8.6 d	7.2 d
20 min.	3.8 d	6.3 d
30 min.	2.3 d	5.75 d
40 min.	1.65 d	5.5 d
50 min.	1.25 d	5.2 d
1 hour	d	5 d
2 hours	0.435 d	4.35 d
4 hours	0.188 d	3.75 d
8 hours	0.082 d	3.3 d
24 hours	0.022 d	2.65 d

It is important to note that almost half the infinity dose is obtained in the first 2 hours.

Further implications of radioactive decay are discussed in paragraph 12 where an attempt is made to estimate the casualties which might be caused under different conditions.

10 Residual contamination on water

The dose rate contours in Fig. 2. do not strictly apply over the water. Gamma radiation persists only as long as the contamination remains on the surface. Even on land, half to two thirds could be removed by efficient hosing down of buildings and roads where this was feasible. On water the deposited fission products would quickly be mixed in with the water and a large proportion of the gamma ray energy absorbed by the water itself (see also CD/SA 42).

The main contamination in the water would arise from the fission products trapped at the actual time of the explosion and this would be very heavy for a short time. With the tide flooding, this contamination would be carried upstream for about 2 miles by the time of high water. All vessels would be contaminated to some degree at the water line and internally if they failed to shut down underwater intakes. As the tide fell, contamination would be left on and below the high water mark, but this would not give rise to a serious gamma ray risk to people using the river.

Re-entry craft (suitably fitted) should be able to work into the port after about 2 hours and other vessels could use the Mersey with comparative safety in a few days.

11 Crater

The explosion might produce a crater about 1000 ft. in diameter scoured to a maximum depth of about 20 feet below the original river bed. The crater lip might reduce the depth of water in the way of the entrance to Gladstone and Canada Docks from 40 feet to 25 feet. There would still, however, be 45 feet of water at highwater neaps so that the subsequent passage of ships in and out of the docks would not be prevented.

The mud on the lip of the crater would be highly radioactive but the radiation from it would be largely absorbed in the water above and would not be a source of danger unless it were dredged up from the bottom.

12 Casualties from blast-damage, initial nuclear radiation and heat flash for both forms of attack

Blast damage

For both types of attack it is assumed that there has been no special shelter provision. For the warned night attack it is assumed that people have occupied the safest position in the house and under these circumstances fatal casualties can be calculated according to the method described in the C.D. Training Branch memorandum on "The Estimation of the Effects of Atomic Bomb Attacks on Cities", but making the necessary allowances for the reduction in range of blast damage.

For the sabotage daylight attack people would be distributed over all floors of buildings such as shops, warehouses, and offices, and usually on the ground floors of ordinary houses; under these conditions, casualties would be considerably increased. In the Fly Bomb (VI) raids when warning was usually given and people were able to move to safe locations the number of people killed per Fly on London was 2.2. In the L.R.R.P.(V2) raids where there was no warning at all, the number of people killed per Rocket on London was 4.9. This indicates that the casualty rates used in the standard method for a warned attack should be at least doubled for the sabotage daylight attack.

For people in the open there are no firm casualty data, and for exercise purposes it is probably accurate enough to assume that everyone would be killed out to a certain range and that no one would be killed beyond this range. For this particular explosion the range appears to be about 4000 ft.

The fatal casualty rates that have been assumed are summarised in Table 2.

TABLE 2

Estimated fatal casualties due to blast damage (percentages)

	Distance from ground zero in 1000 ft.			
	0-1	1-2	2-3	3-4
Indoors (warning)	100	80	40	10
Indoors (no warning)	100	100	80	20
In the open	100	100	100	100

The numbers of fatal casualties based on these percentages are as follows:-

TABLE 3

Estimated fatal casualties due to blast damage (numbers)

Bomb	Sabotage daylight attack			Warned night attack		
	Indoors	In the open	Total	Indoors	In the open	Total
No.1	7,800	2,800	10,600	2,800	-	2,800
No.2	14,000	6,000	20,000	3,500	-	3,500

Initial nuclear radiation

As already noted in paragraph 8 it is assumed that there would be no fatal casualties due to initial nuclear radiation amongst people indoors.

For people in built-up areas in the open it is also assumed (see paragraph 8) that the dose received at any given range would be half that from an air burst bomb and this can be translated into percentage lethality by means of the Medical Research Council data given in Table 5. We can of course neglect all those within the 4,000 ft. radius since we have assumed that they would already have been killed by blast (see Table 2). Beyond this range the figures for those not already killed by blast are:

4 to 5000 ft. 5% lethal dose

which produces only a trivial number of extra fatal casualties.

Heat flash

Owing to the nature of the assumed explosions and the enormous shielding at ranges beyond 4000 ft. where there would still be survivors in the open, it is considered that there would be no fatal heat flash casualties and only a few non-fatal casualties.

13 Casualties in the open due to gamma radiation from fall-out - sabotage daylight attack only

Since we have already assumed that blast damage kills everyone in the open up to 4,000 ft. we are only concerned with those in the open beyond this distance.

It is assumed that fall-out is effective from 5 minutes after the explosion (see paragraph 9).

Now we can either assume that everyone has been very well trained and that as soon as they realise that they are in a heavy fall-out area they make for the nearest cover, or we can assume that the attack is more or less a bolt from the blue, and that it might be 15 minutes or even half an hour before the streets could be cleared.

In the first case we shall assume that people in the open are subjected to the radiation for an effective period of 2 minutes. Some people could take cover in a much shorter time than this, but they first have to realise that they are in danger, and although they would have heard the explosion, there would be large areas where evidences of blast would be comparatively slight. Then there are the people who would have to be emptied from cars, trams, and buses; these would be much slower in finding cover in what might easily be a strange area. All in all it is considered that 2 minutes effective exposure is the very least that could be postulated, although the advantage of reducing this exposure by intensive training is obvious from Table 4.

In each category the dose received during the period of exposure in the open would be the difference between the infinity dose from 5 minutes and that from the last time of exposure. These figures would be:

(a) 5 min. to 7 min. $8.2d - 7.7d = 0.5d$

(b) 5 min. to 20 min. $8.2d - 6.3d = 1.9d$

(c) 5 min. to 35 min. $8.2d - 5.6d = 2.4d$

The doses received at different contours under these conditions would be as shown in Table 4.

TABLE 4

Dose received (r) at different contours for different durations of exposure

Contour r/hr @ 1 hr	Duration of exposure (min.)		
	2	15	30
5000	2,500	9,500	12,000
2000	1,000	3,800	4,800
1000	500	1,900	2,400
500	250	950	1,200
100	50	190	240
10	5	19	24
1	-	2	2

The data for converting these doses into mortality rates have been provided by the Medical Research Council; they are reproduced in Table 5.

TABLE 5

Single dose range (r)	Mortality at 24 hours	Mortality at 6 months	Number incapacitated in 24 hours	Probable time of unfitness for any duty of those affected.
0 - 25	0	0	Negligible	2 - 3 days
25 - 75	0	0	A few	2 - 3 days
75 - 100	0	0.1%	Up to half	1 - 2 weeks
100 - 150	0	0.5%	At least half	About 3 weeks
150 - 200	0	Up to 5%	At least 3/4	Not less than 3 weeks. Some v. ill.
200 - 400	Unlikely to be any	About 1/3	Probably all	Not less than 3 months
400 - 600	Perhaps a few	About 1/2	"	" "
800	Likely to be some	Almost all	"	-

Taking the data of Tables 4 and 5 together we have the following approximate values (Tables 6 and 7) for the average gamma ray lethality between successive dose rate contours beyond 4,000 ft, together with the numbers of people likely to be affected.

Average gamma ray lethality from fall-out between successive contours, and estimated numbers of people affected beyond 4000 ft. (daytime, no evacuation)

TABLE 6 (No. 1 Bomb)

Between contours	Number of people in the open beyond 4,000 ft.	Duration of exposure (min.)					
		2		15		30	
		% killed	Number	% killed	Number	% killed	Number
5000 & 2000 r/hr @ 1 hr	2,760	100	2,760	100	2,760	100	2,760
2000 & 1000 "	2,580	80	2,060	100	2,580	100	2,580
1000 & 500 "	3,600	30	1,080	100	3,610	100	3,610
500 & 100 "	14,890	5	750	40	5,960	60	8,930
100 & 10 "	20,400	-		1	200	3	610
Totals (approx.)			6,700		15,200		18,500

TABLE 7 (No. 2 Bomb)

Between contours	Number of people in the open beyond 4,000 ft.	Duration of exposure (min.)					
		2		15		30	
		% killed	Number	% killed	Number	% killed	Number
5000 & 2000 r/hr @ 1 hr	5,950	100	5,950	100	5,950	100	5,950
2000 & 1000 "	2,540	80	2,030	100	2,540	100	2,540
1000 & 500 "	5,510	30	1,650	100	5,510	100	5,510
500 & 100 "	22,600	5	1,130	40	9,040	60	13,560
100 & 10 "	26,930	-	-	1	270	3	810
Totals			10,800		23,300		28,400

14 Total fatal casualties

If we combine the figures of Tables 3, 6 and 7, the total fatal casualties for the different conditions postulated are as given in Table 8.

TABLE 8

Estimated total fatal casualties (to nearest 1000)

Bomb	Sabotage daylight attack			Warned night attack
	2 min. exposure	15 min. exposure	30 min. exposure	
No. 1	17,000	26,000	29,000	3,000
No. 2	31,000	43,000	48,000	4,000

The figure for the warned night attack would almost certainly be somewhat higher in practice because there would always be some people in the open, and if the sabotage attack took place at any other time of the day, there would be fewer people in the open, and therefore fewer casualties.

Seriously wounded people who had also received a heavy - though not necessarily lethal dose of gamma radiation - would have a much smaller chance of recovery than otherwise and this would tend to increase the number of fatal casualties.

15 Casualties to people inside buildings due to residual gamma radiation from fall-out

Until more detailed information is available on the average energy of the gamma rays from fission product fall-out and the penetration of low energy radiation through concrete and brickwork, it is impossible to make any more than a rough guess at the average dose rate inside a building corresponding to the dose rate in the open, especially when the wide variation of shielding from different directions in a built-up area is taken into account. There is reason to suppose that as long as people keep as close to the centre of the building as possible and away from windows, the outside dose is reduced by a factor of about 100.

Assuming this value for this exercise then at the 1000 r/hr @ 1 hr contour outside, the dose accumulated inside in 8 hours would be 50 r, 40 of which would be accumulated in the first 2 hours; it will be seen from Table 5 that this would not produce any fatal casualties. If the dose rate outside was as high as 10,000 r/hr @ 1 hr the 8 hr dose inside would be 490 r - a 50% lethal dose, but with our assumed contamination this dose rate would be inside the 4000 ft. range of 100% fatal casualties from other causes.

In between these contours some fatal casualties must be expected as well as a high proportion of radiation sickness. Thus between the 5,000 r/hr @ 1 hr and the 2,000 r/hr @ 1 hr contour there would be 11,000 people indoors beyond the 4,000 ft. range in the case of No. 1 Bomb, and 24,000 in the case of No. 2. The dose accumulated by these people in 8 hours would vary from 250 r down to 100 r and this would probably cause about 10% fatal casualties (see Table 5) i.e. 1,100 in the case of No. 1 and 2,400 in the case of No. 2. 80% of this dose would have been accumulated in the first 2 hours.

16 People entering the contaminated area after the explosion for emergency work

The difficulties of moving people into the contaminated area after the explosion to carry out emergency operations can be seen by reference to Table 9 in which are set out the times before the dose rate is down to 1r/hr and the times taken to accumulate a dose of (a) 25 r and (b) 100 r at different dose rate levels, and from different starting times.

These two figures have been chosen since although 25 r has been so far generally accepted as a possible wartime permissible dose, it is obvious from Table 5 that the risk of incurring any more than slight radiation sickness for doses up to 100 r is small and might have to be accepted under these extreme conditions.

TABLE 9

Times taken to accumulate 25r and 100r

	Dose rate in r/hr @ 1 hr			
	1000	500	100	10
Time before dose rate is down to 1 r/hr	13 days	7 days	2 days	7 hours
Starting at 4 hr Initial dose rate (r/hr) Time for 25r " " 100r	188 8 min. 35 "	94 16 min. 1 hr. 15 min.	18.8 1 hr. 40 min. 15 hr	1.88 40 days Never
Starting at 8 hr Initial dose rate (r/hr) Time for 25r " " 100r	82 20 min. 1 hr. 10 min.	41 40 min. 3 hr.	8.2 4 hr. 40 hr.	0.82 14 months Never
Starting at 12 hr Initial dose rate (r/hr) Time for 25r " " 100r	50 30 min. 2 hr. 20 min.	25 1 hr. 5 hr.	5 6½ hr. 80 hr.	0.5 10 years Never
Starting at 24 hr Initial dose rate (r/hr) Time for 25r " " 100r	22 1 hr. 10 min. 5 hr. 15 min.	11 2 hr. 30 min. 11 hr.	2.2 16 hr. 10 days	0.22 A lifetime Never

It is important to note that the above times are calculated for uninterrupted exposure, and the great advantage of shift work is immediately obvious. Thus on the 100 r/hr @ 1 hr contour, people who started work at 8 hours and worked a 4 hr. shift would accumulate 25r, but by the time they came back again - say at 24 hours - the dose rate would have fallen to such an extent that it would take them 16 hours of continuous exposure and many days of intermittent exposure to accumulate a further 25r.

At the 500 r/hr @ 1 hr contour it would be necessary to delay access for at least 12 hours and even then 100r would be accumulated in 5 hours. A delay of 24 hours would extend this time to 11 hours.

The adoption of a 25r permissible dose instead of a 100r would almost certainly push the whole operation back from the 500r/hr @ 1 hr contour to the 100 r/hr @ 1 hr contour.

17 The problem of rehabilitation in the heavily contaminated areas

In the heavily damaged areas, questions such as the reopening of the docks, the clearance of debris, the demolition of dangerous structures etc., would eventually have to be considered in relation to the degree of contamination which existed. Heavy contamination however would extend beyond the area of heavy damage and the housing problem alone would call for a speedy return to life in this area which would have to be preceded by decontamination on a very large scale. Operations such as these would involve the employment of large teams of workers on a shift basis, who would have to be brought into the area from uncontaminated areas outside, and it now remains to discuss what considerations should determine their initial time of entry and the period during which they could be safely used.

It will be assumed for simplicity that the whole of an 8 hour shift would be spent in the open so that the dose accumulated would be approximately $\frac{1}{3}$ of that for 24 hours. This assumption is only approximate since soon after the explosion the decay is so rapid that much more of the 24 hour dose would be accumulated in the first 8 hours than in the last, but as we are here mostly concerned with times several days after the explosion and onwards, and since most of the work would take place in the middle part of the day anyway, the assumption is fair enough.

Any part of the 8 hours spent under cover would reduce the dose and give a useful factor of safety, but the assumption of a full 8-hour exposure would offset any more rapid decay due to weathering over and above that due to normal radioactive decay.

The Medical Research Council have suggested that the following criteria should govern the employment of civilian or Civil Defence workers under such conditions.

(a) Not more than 25r in the first day

(b) " " " 75r in the first week

(c) " " " 200r in two years

The basic tables which enable such calculations to be made are given here as Tables 10 and 11.

Table 10 gives the doses which would be received in successive periods of time in the open for continuous exposure at different dose-rate contours.

Table 11 gives similar figures for 8 hour shift-work, i.e. assuming that only $\frac{1}{3}$ of the time is spent under exposure, together with the accumulated dose in two years.

TABLE 10

The doses received in successive periods in the open for continuous exposure at different dose-rate contours

Time after explosion of first exposure T (hr.)	$T^{-1.2}$	Dose to infinity where d = dose rate at 1 hour (r)	Dose received in each successive period (r)	Dose received when d has the following values				
				5,000	2,000	1,000	500	100
5 min. .0833	19.724	8.218d						
			5.570d	27,850	11,140	5,570	2,785	557
1 day 24	.022067	2.648d						
			.343d	1,715	686	343	172	34
2 " 48	.0096054	2.305d						
			.179d	895	358	179	90	18
3 " 72	.0059048	2.126d						
			.119d	595	238	119	60	12
4 " 96	.0041809	2.007d						
			.088d	440	176	88	44	9
5 " 120	.0031987	1.919d						
			.068d	340	136	68	34	7
6 " 144	.0025702	1.851d						
			.057d	285	114	57	29	6
7 " 168	.0021360	1.794d						
			.229d	1,145	458	229	115	23
2 weeks 336	.00092980	1.565d						
			.125d	625	250	125	63	13
3 " 504	.00057159	1.440d						
			.080d	400	160	80	40	8
4 " 672	.00040473	1.360d						
			.060d	300	120	60	30	6
5 " 840	.00030965	1.300d						
			.168d	840	336	168	84	17
10 " 1680	.00013478	1.132d						
			.147d	740	294	147	74	15
20 " 3360	.000058667	.985d						
			.171d	855	342	171	86	17
52 " 8736	.00001864	.814d						

TABLE 11

The doses received in successive periods in the open for 8 hour/day exposure at different dose-rate contours

Time after explosion of first exposure	Dose received on each successive period when d has the following values (r)				
	5,000	2,000	1,000	500	100
5 min.					
1 day	9,280	3,710	1,860	928	186
2 "	572	229	114	57	11
3 "	298	119	60	30	6
4 "	198	79	40	20	4
5 "	147	59	29	15	3
6 "	113	45	23	11	2
7 "	95	38	19	10	2
2 weeks	382	153	76	38	8
3 "	208	83	42	21	4
4 "	133	53	27	13	3
5 "	100	40	20	10	2
10 "	280	112	56	28	6
20 "	247	98	49	25	5
52 "	285	114	57	29	6
Infinity dose from double line	1,357	657	433	320	88
Dose from 2 years to infinity * 0.7d/3	1,167	467	233	117	23
Dose in 2 years	190	190	200	203	65

* [The 2-year dose for full exposure in the open is obtained by subtracting the infinity dose from 2 years onwards from the infinity dose from any time T given in Table 10. Thus 2 years = 17,500 hours

$$T^{-1.2} = 8 \times 10^{-6}$$

and infinity dose from 2 years = $5 \times 17{,}500 \times 8 \times 10^{-6} \times d = 0.7d$]

The double lines are drawn in Table 11 so that all the values below them satisfy conditions (a), (b), and (c). Thus at -

100 r/hr @ 1 hr	work could be started after 1 day and this would give a generous factor of safety on all counts,
500 " " "	work could be started after 5 days; this would give 11r on the first day, about 50r on the first week and 203r in 2 years,
1000 " " "	work could not be started until after 5 weeks; this would give small initial doses but still 200r in 2 years,
2000 " " "	work could not be started here until after 20 weeks, the 2 year dose again being the controlling factor,
5000 " " "	work could not be started for a whole year, the 2 year dose still being the controlling factor.

From this it is seen that in the heavy contamination area particularly, the 2 year dose is the controlling factor. Much of the work would not take anything like this time and in any event natural weathering and decontamination would probably help to reduce the risk greatly over such a protracted period; for such conditions it is suggested that factors (a) and (b) only should be considered. The entry times would then be as follows:-

100r/hr @ 1 hr	1 day as before
500 " " "	after 3 days
1000 " " "	after 2 weeks
2000 " " "	after 3 weeks
5000 " " "	after about 6/7 weeks.

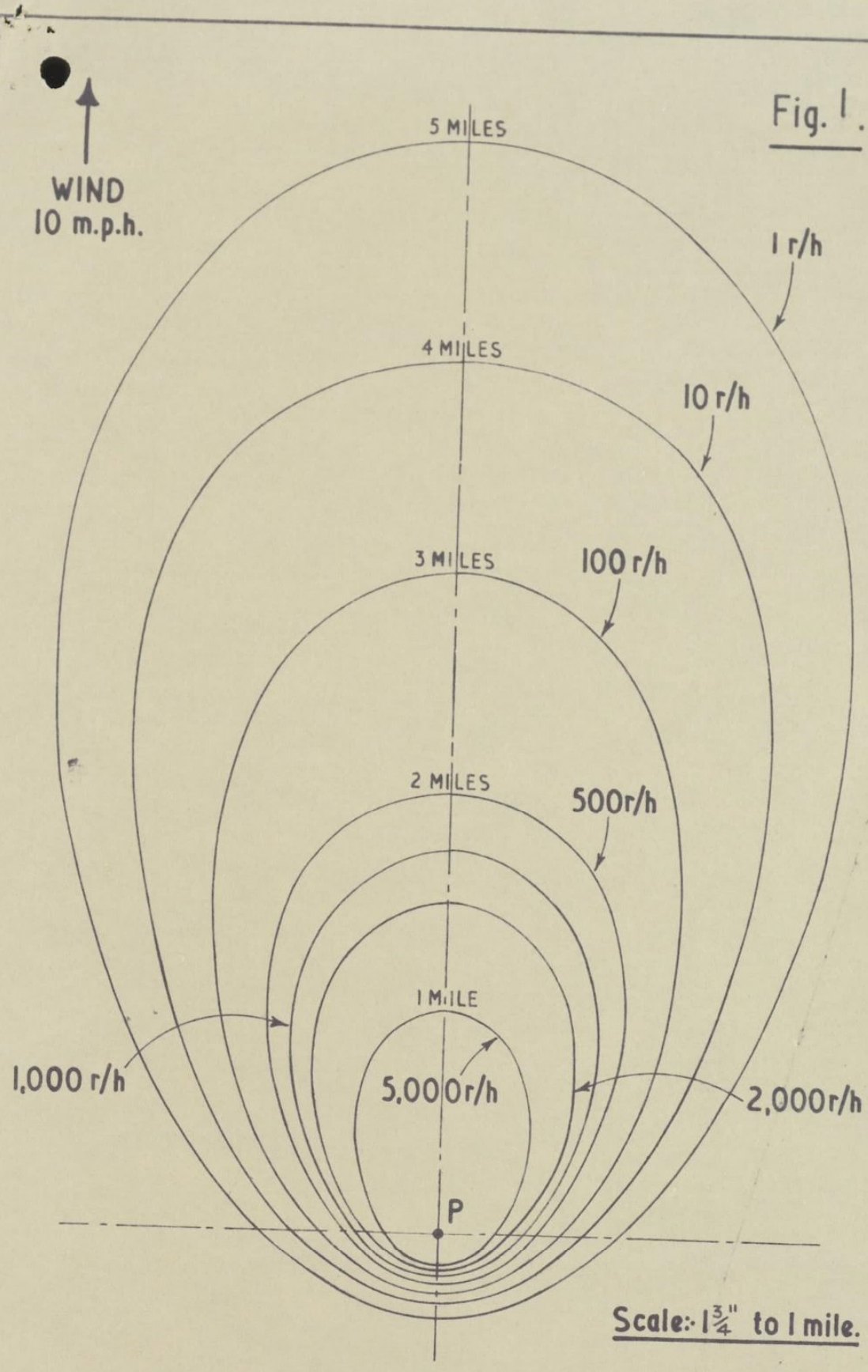
The operation of either of these controls would be extremely complicated and in practice we should be almost forced to adopt some simplified scheme involving for example two classes of people -

(a) those whose jobs would take less than a week when a round 100r for the period could be allowed, and

(b) those whose exposure might be for a period of some months or even years when the controlling factor should probably be the limit of 200r in 2 years. For a 40 hour week this would be .05r/hr. This would be enormously restrictive but might be inevitable.

G.R.S.
OSA 54/3/11

Fig. 1.



ESTIMATED LAND CONTAMINATION AT 1 HOUR FROM A SHALLOW UNDERWATER BURST AT P.

HOME OFFICE
SCIENTIFIC ADVISER'S BRANCH

Annuli for calculation of prompt casualties from groundburst bombs

by W. F. Greenhalgh, B.Sc. October, 1962.

Summary

The basic scheme of the method is depicted in Fig. 1. The approximate number of people killed is obtained by taking 100% of the people contained within the central disc. The number of trapped is obtained by taking 30% of the number of people within the inner annulus; and the number of people untrapped and yet seriously injured is obtained from 5% of the total number of people between the 100% killed disc and the outer circle. The radii are given for a number of yields in Table 2.

For calculations based on averaged population density, Table 3 may be used. The number of casualties is obtained by multiplying the average population density, per square mile, within an annulus by the value from columns 2, 5 or 6 as appropriate.

Description

The prompt casualty percentages were obtained from Exercise ARC Fig. 1 (corrected) - see Fig. 4. If $f(r)$ is the fraction of people becoming a certain type of casualty (e.g. killed) at distance r miles from GZ, with uniform population density ρ persons per sq. mile, then the total number of this type of casualty between radii r_1 and r_2 miles from GZ is

$$N = \int_{r_1}^{r_2} f(r).\rho.2\pi r.\ dr = 2\pi\rho\int_{r_1}^{r_2} r.f(r).dr.$$

$r.f(r)$ is plotted against r for a 10-MT groundburst bomb in Figs. 2 and 3. The areas under these curves are proportional to the number of casualties of the stated type in a territory having uniform population density.

The numbers of casualties with a uniform population density of 1 person per sq. mile were obtained from Fig. 2 using a planimeter. They are given below in Table 1. The ratios between the numbers of the three types of casualty remain fixed for different yields. The numbers of a given type of casualty between two given blast pressures is proportional to $(\text{yield})^{\frac{2}{3}}$.

Table 1

Casualties from a 10-MT groundburst bomb with a population density of 1 per sq. mile

Type of casualty	Casualties	Percentage of total casualties
Killed	25.9	39.3
Trapped	26.5	40.1
Untrapped seriously injured	13.6	20.6

To find the radius of the 100% killed disc.

$$1.0.\ \pi\ r^2 = 25.9$$

$$r = 2.87 \text{ miles (blast pressure 16.3 p.s.i.)}$$

To find outer radius of 30% trapped annulus.

$$0.30.\pi(r^2 - 2.87^2) = 26.5$$

$$r = 6.03 \text{ miles (4.3 p.s.i.)}$$

To find outer radius of 5% U.S.I. annulus.

$$0.05.\ \pi\ (r^2 - 2.87^2) = 13.6$$

$$r = 9.73 \text{ miles (2.08 p.s.i.)}$$

The corresponding radii of the killed, trapped and seriously injured annuli for other bomb powers are given in Table 2. In Table 3 these radii are converted to areas; the Table also gives (cols. 5 and 6) the factors by which the population densities (expressed in persons per sq. mile) must be multiplied to determine the numbers trapped and seriously injured.

Table 2

Radii of annuli for various bomb powers

Yield	Radius of 'killed' circle (16.3 p.s.i.)	Larger radius of 'trapped' annulus (4.3 p.s.i.)	Larger radius of 'untrapped seriously injured' annulus (2.08 p.s.i.)
100 KT	0.62 mile	1.30 mile	2.09 miles
200 "	0.78 "	1.63 "	2.64 "
500 "	1.06 "	2.22 "	3.58 "
1 MT	1.33 "	2.80 "	4.52 "
2 "	1.68 "	3.53 "	5.69 "
3 "	1.92 "	4.03 "	6.50 "
5 "	2.28 "	4.78 "	7.73 "
10 "	2.87 "	6.03 "	9.73 "
20 "	3.62 "	7.60 "	12.26 "
50 "	4.91 "	10.32 "	16.63 "
100 "	6.19 "	13.00 "	20.95 "

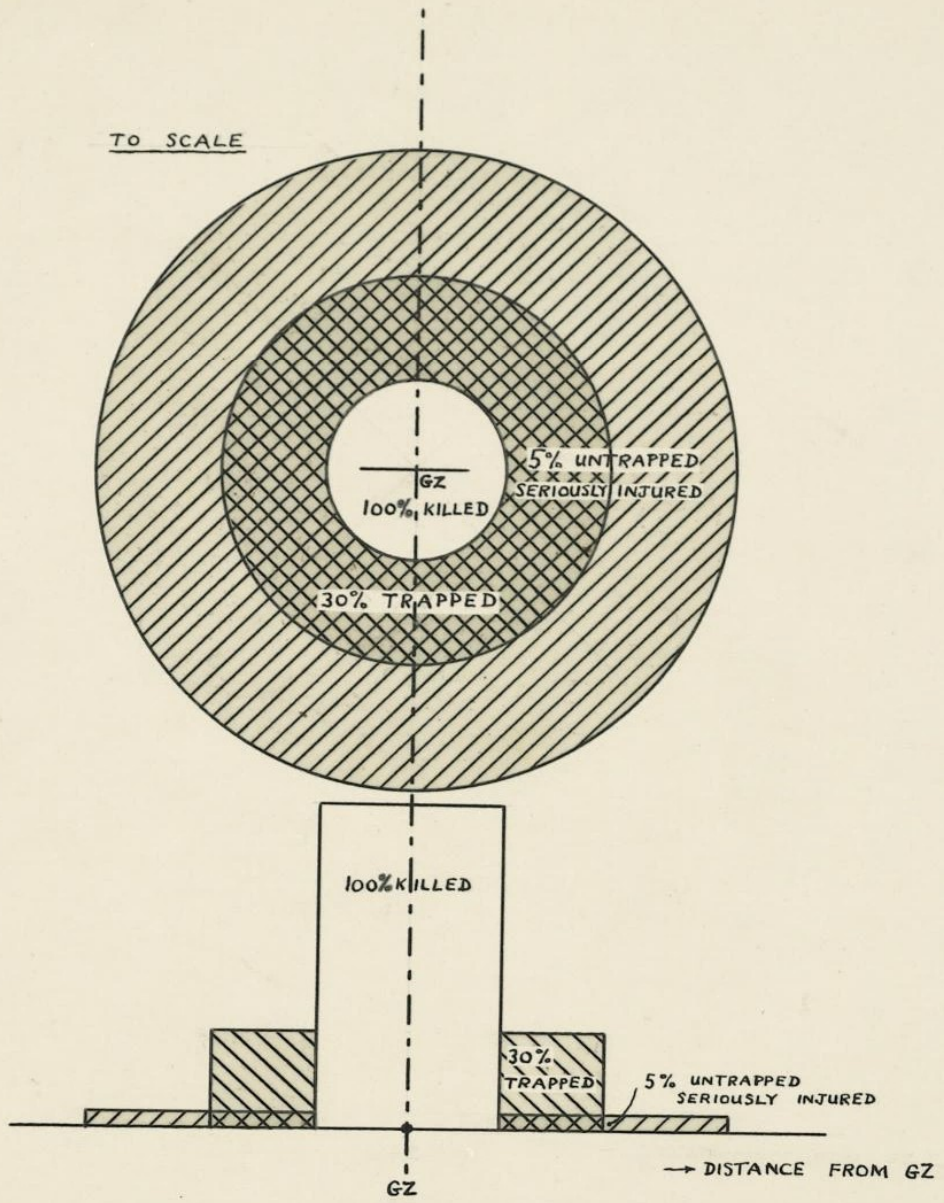


Fig. 1. The central 'killed' disc and the 'trapped' and 'untrapped seriously injured' annuli.

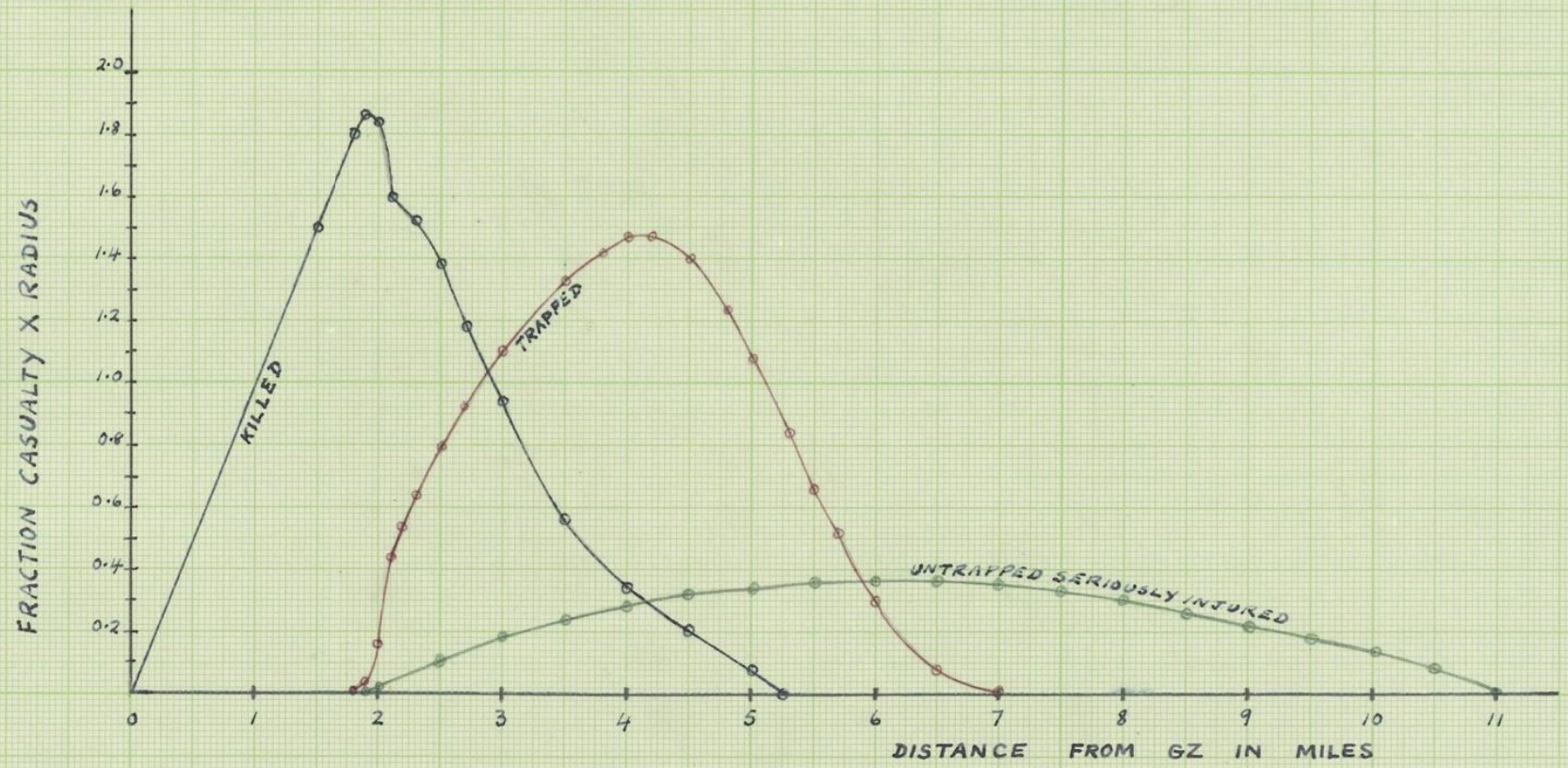


FIG. 2. 10-MT. GROUNDBURST CASUALTIES.

N.B. AREAS UNDER CURVES PROPORTIONAL TO NUMBERS OF CASUALTIES WITH UNIFORM POPULATION DENSITY.

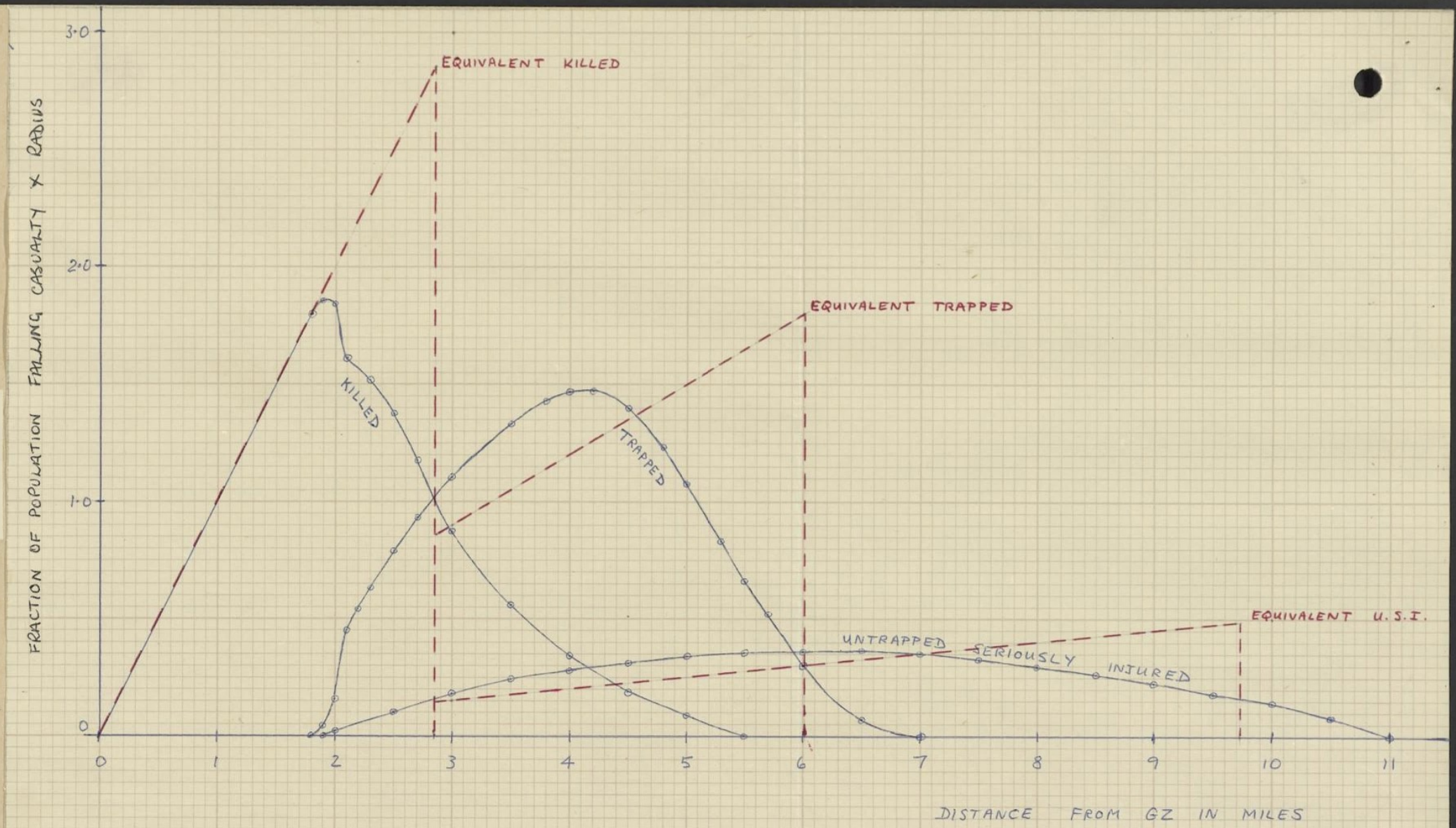


Fig. 3. 10 · MT GROUNDBURST : EQUIVALENT CASUALTY ANNULI.

N.B. AREAS UNDER CURVES ARE PRORTIONAL TO NUMBERS OF CASUALTIES WITH UNIFORM POPULATION DENSITY.

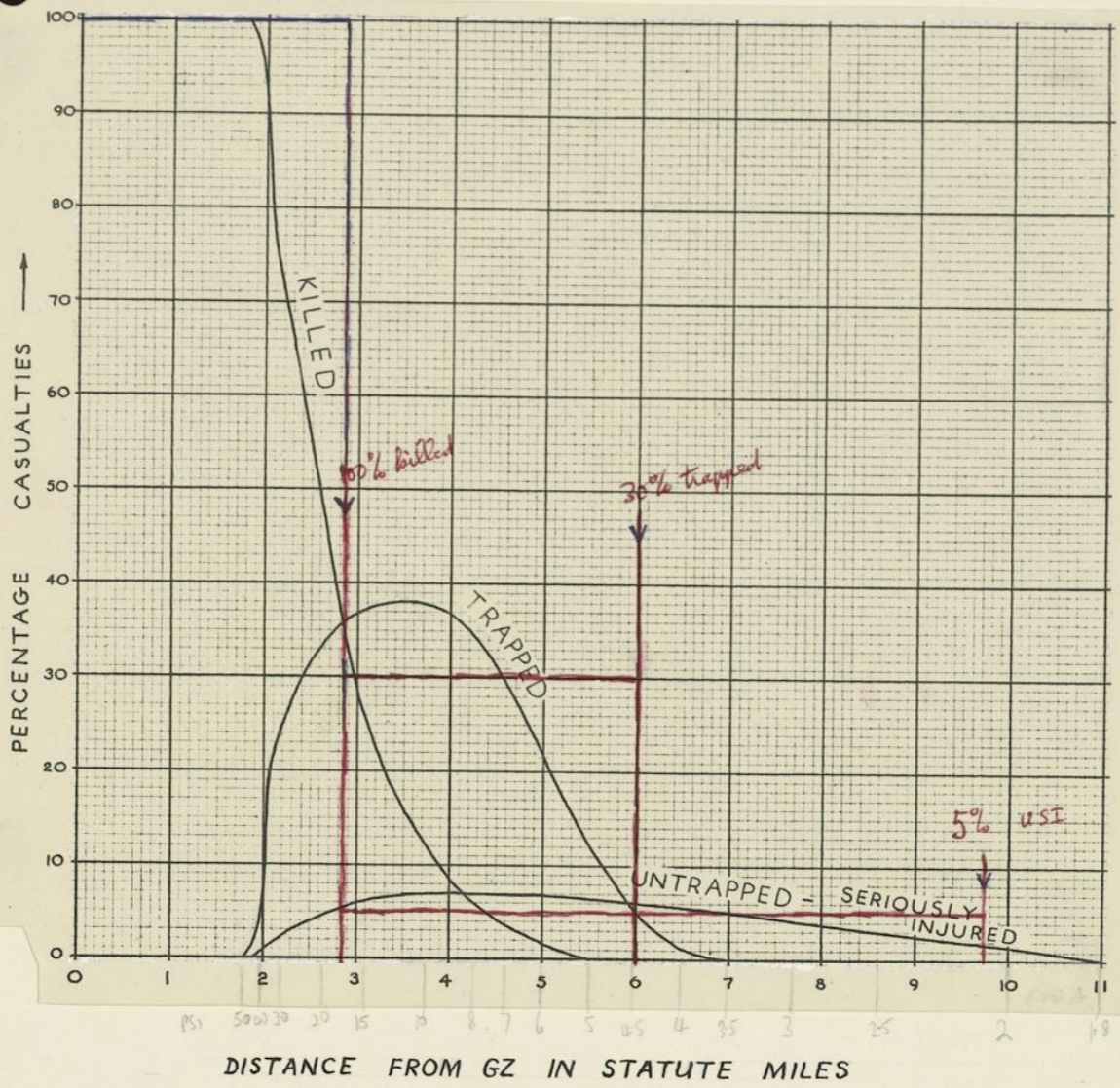


Fig. 4. Casualties due to immediate effects of a 10-MT groundburst - people protected from heat flash, in British houses.

Table 3

Areas and casualty factors of annuli

Yield	Areas in sq. miles			Casualty factor (at 1 person per sq. mile)	
	Killed circle	Trapped annulus	U.S.I. annulus	0.30 x Area of trapped annulus	0.05 x Area of U.S.I. annulus
(1)	(2)	(3)	(4)	(5)	(6)
10 KT	0.260	0.885	2.72	0.265	0.136
20 "	0.413	1.41	4.30	0.420	0.216
50 "	0.760	2.60	7.90	0.770	0.397
100 "	1.20	4.1	12.6	1.23	0.630
200 "	1.90	6.5	20.0	1.95	1.00
500 "	3.52	12.0	37.0	3.60	1.84
1 MT	5.60	19.1	59.0	5.70	2.93
2 "	8.90	30.3	93.0	9.10	4.65
3 "	11.6	40.0	122	11.9	6.10
5 "	16.3	56.0	171	16.7	8.60
10 "	26.0	88.5	272	26.5	13.6
20 "	41.0	141	430	42.0	21.6
50 "	76.0	260	790	77.0	39.7
100 "	120.0	410	1,260	123	63.0

APPENDIX A

Table for calculating the radii and areas of the annuli for various yields

The radii of the annuli are obtained by multiplying the radii for a 10-MT bomb by the factor in column 3. Similarly the areas of the annuli are obtained using the values in column 5.

Yield (1)	$\lceil \text{Yield (KT)} \rceil^{\frac{1}{3}}$ (2)	$\lceil \text{Yield (KT)} \rceil^{\frac{1}{3}} \div 21.54$ (3)	$\lceil \text{Yield} \rceil^{\frac{2}{3}}$ (4)	$\lceil \text{Yield} \rceil^{\frac{2}{3}} \div 464.2$ (5)
10 KT	2.154	0.100	4.642	0.0100
20 "	2.714	0.126	7.365	0.0159
50 "	3.684	0.171	13.57	0.0292
100 "	4.642	0.215	21.55	0.0464
200 "	5.848	0.271	34.20	0.0737
500 "	7.937	0.368	63.01	0.1357
1 MT	10.0	0.464	100.00	0.2155
2 "	12.599	0.585	158.8	0.3425
3 "	14.422	0.668	208.0	0.448
5 "	17.100	0.794	292.4	0.630
10 "	21.54	1.000	464.2	1.000
20 "	27.14	1.26	736.5	1.585
50 "	36.84	1.71	1357.0	2.92
100 "	46.42	2.153	2155.0	4.64

UK National Archives

HO 225/13, Home Office: Scientific Adviser's Branch: Reports (CD/SA Series), "The economic and social effects of the German air attacks on certain British cities," 1949 – 145 pages

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THE ECONOMIC AND SOCIAL EFFECTS OF THE GERMAN AIR ATTACKS ON CERTAIN BRITISH CITIES

The manuscript of this report was largely completed by Dr. T. McKeown and Dr. F. Yates before they left the Research and Experiments Department of the Ministry of Home Security.

The editor (E.C. Allen) has made various additions and amendments and has also added Chapter 8 - "Discussion and Conclusions" - and the Summary. The report has been produced without reference to Dr. McKeown and Dr. Yates so that responsibility for any shortcomings rests with the editor.

THE ECONOMIC AND SOCIAL EFFECTS OF THE GERMAN AIR ATTACKS ON CERTAIN BRITISH CITIES

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SUMMARY

1. The report analyses the results of thirteen social surveys made after raids on eleven British towns by Dr. T. McKeown with the collaboration of Dr. F. Yates, together with other relevant information from the Norwich shoe industry, Messrs. Singer's at Clydebank, and the Port Labour Officer at Liverpool.

2. Details are given of the survey method and suggestions made for future surveys of a similar nature.

3. The effectiveness of attack is expressed by four indices; the effective density of bombs, the percentage of buildings destroyed, the percentage of houses destroyed, and the casualties per thousand population, which are all shown to be valid measures.

4. The movements of population following air attacks are considered as movements within the town, trekking and evacuation. Evacuation is, in turn, divided into

(1) Evacuation to contiguous built-up areas,

(2) Evacuation to places within daily reach of the town but separated from it by open country,

and (3) Evacuation to places beyond daily reach of the town.

5. It is shown that evacuation and trekking together are, in general, proportional to the effectiveness of the attack and the percentage of people moving thus is three times that of the houses destroyed and thirty times that of the people killed. The movements of workers in relation to the degree of house damage are analysed and a curve is given from which the proportions of people, evacuating, trekking, moving in the town or staying at home may be estimated for up to 35% of houses destroyed. The proportion evacuating with 35% of houses destroyed, corresponding to about 75% of houses uninhabitable, is likely to be 90% while trekkers will form only 1% of the whole. Trekking will be at a maximum (20% of the population) with about 15-20% of houses destroyed.

6. The evaluation of loss of time from work after air attack was a major objective of the surveys, and this was done for three weeks after a raid, for sixteen weeks, and for a period of about two years. Loss of time only included that due to air raids, i.e. either to lack of work due to damage to the place of work, to wounds or to personal reasons other than sickness. It is shown that loss of time from work is in general proportional to the effectiveness of attack, however measured, and that on the average every worker in a town lost 0.37 day per 1% of buildings destroyed, 0.40 day per 1% of houses destroyed, 0.15 day per metric ton of bombs per square mile (effective density over the whole town) and 0.81 per fatal casualty per 1,000 population. These figures are for the first three weeks after a raid. The loss for the sixteen-week period is found to be greater by a factor of 1.5 and that for the two-year period by a factor of 2.5.

7. Loss of time is then divided into two kinds, that beyond the workers' control, i.e. that due to work not being available or to injuries, and that described as time lost for personal reasons. Time lost for personal reasons is shown to be also, in general, proportional to the effectiveness of attack and to be, for each index of effectiveness of attack, two-thirds of the time lost from all causes.

8. The relationship between absenteeism for personal reasons and degree of house damage is studied and it is shown that, on the average, a worker loses six days when his house is totally destroyed or rendered permanently uninhabitable, and three days if the house is temporarily uninhabitable. Much of this time is, presumably, spent in seeking alternative accommodation and moving into it.

9. Consideration of absenteeism for personal reasons in relation to movements of population shows that most time is lost in connexion with evacuation. Surprisingly, no more time was lost by those trekking from than by those living and sleeping in undamaged houses.

10. It is reasonable to suppose that those workers not absent following an air attack might suffer some loss in efficiency and this has been investigated by a survey in Norwich and by examination of the records of firms in the Norwich shoe industry and of Messrs. Singer's at Clydebank. It is shown that there is a general loss of about 10% of productivity for about two weeks after a raid. At Norwich, the efficiency of male workers remained about the same, but that of the female workers dropped by about one-third for the week following the attack.

11. The state of morale of workers, as it directly affects the war effort, may be measured by the amount of unnecessary absenteeism. There is a rate of absenteeism for personal reasons, related to the intensity of attack given in para. 7 above, which carries no implications as to the state of morale since as the destruction of houses increases more time must be taken from work to attend to essential personal duties such as finding new accommodation. In three towns the loss of time was significantly greater than would be expected from the effectiveness of attack and in these cases, a temporary lowering of morale (in the general sense) was also recorded at the time. Thus, there is evidence that loss of morale, as generally understood, is related to excessive loss of time for personal reasons and this is supported by evidence in Appendix XIII which relates press comment, indicating loss of public confidence, to loss of time for personal reasons.

12. Considering next total loss of production from air attack, it is shown that the loss from a given weight of bombs on a factory area will be four to five times that of the same weight on a residential area allowing for loss of workers' time in both cases as well as for replacement of factory buildings and stock and for repair of damaged houses. This assumes little or no damage is caused by fire.

13. A series of tables, one for each of the eleven towns studied, are included each of which gives figures for time lost by workers in a number of industrial groups in the town. These tables show that workers in Government service and transport lost, on the average, least time.

14. A study of the movements of labour and changes of employment from 1939-1943 is given in Appendix X. Six towns were studied and of these Grimsby suffered greater change than any of the other towns. A complete analysis was made only in the case of Plymouth where 17% of workers changed their employment. Of these, all changed their employers, 12% changed their industry and 8% their occupation, and of those who changed, 87% changed once, 12% twice and only 1% more than twice. Changes of employment were made by 12% of male workers as compared with 16% of female workers.

15. Finally, the report includes, as Appendices XI and XII, two contributions on trekking. The first is an account of a personal experience of trekking and the second a summary by a psychiatrist of the effects of severe personal experiences in air attack and gives his opinion that trekking was a major factor in recovery from such experiences.

1. GENERAL INTRODUCTION

In 1939 very little was known of the effectiveness of bombing. The air raids in Spain and China had not been examined critically, and the reports which emerged, part legend and part fact, were of little use in the design of protection. It was therefore necessary to institute a research which would provide a definite measure of the risks to be faced, and give some indication of the protection which it would be practical to offer.

This work was undertaken by the Research and Experiments Department of the Ministry of Home Security, under the Chief Adviser, Sir Reginald Stradling, and until the autumn of 1941 the Department was concerned almost exclusively with the defensive problem. In November 1941, however, an attempt was made to examine critically the raiding experience of this country from the offensive point of view. Surveys were begun on quite a large scale in Hull and Birmingham, towns which had suffered considerably from raiding in the previous year and were of great importance as a port and industrial centre respectively. Eventually 11 towns were studied of which two were surveyed twice - 13 surveys in all. Data collected were classified as:-

(1) Technical - studies of buildings and plant, and the material damage done by the raids,

(2) Economic - an attempt to assess how far the raids interrupted the essential work of the towns,

(3) Medical and Sociological - a study of the effects of the raids on the civilian populations, which included an assessment of the interference with the various defensive services. In Hull a psychiatrist, Dr. Russell Fraser, assisted by psychiatric social workers, investigated the incidence of neuroses resulting from raids.

Essentially the problem was an economic one. Raids against a town are effective proportionally as they interfere with its essential work, and effects on people and structures are important only as they contribute to this interference.

It was soon evident that while it was easy to collect descriptive data on casualties and material damage, it was very difficult to assess their importance. It was surprising how little useful information many people in authority were able to give about the effects of raids. Usually the tendency was to over-estimate the effects, so that one became used to hearing that just a few further nights' raiding would have created an impossible situation, and this whether the raids had been in progress for days or weeks. Some administrators did of course make shrewd guesses, but the information available to them was not such as would provide a simple answer to so complex a question. Moreover, it is difficult to assess the relative importance of different types of dislocation. A man may feel that if he cannot get his car along the roads, telephone his staff or buy a hot meal things are very serious. Yet such difficulties can by no means serve as a measure of the real obstruction. Thus the investigators were bound to discount much of what they were told, and indeed as some opinions were flatly contradicted by others of equal authority, they could hardly do otherwise.

A further difficulty was the inadequacy for this purpose of the records kept in certain industries. At first it was intended to assess the economic effects of raids on a town by making detailed studies of a random selection of firms. For such a survey it was essential to obtain records of attendance and production for intervals sufficiently short for the effects of the raids to be evident. But it was soon clear that many firms kept no adequate record of their work, and in some cases it is not too much to say that they do not know why they are working in a certain way only that it is profitable to do so.

The Hull and Birmingham surveys showed that neither from industrial records nor from central sources could data be obtained which would measure the overall effect of bombing on the work of a town. A method was needed which could be applied in any raided town, and which would provide material in a form in which it could be related to various indices of the weight of attack. It was thought that these needs might be met by a social survey, based on house-to-house visits. If the population resident in a town at the time of the raids could be identified, the intention was to base the enquiry on information supplied by the people themselves. In this way it was hoped to collect data for the overall economic assessment, and in particular to discover whether effects on the population did result in serious disturbance to the war effort. In particular the survey was designed to determine the industrial distribution of workers at the time of the raids and the post-raid absenteeism in different industries.

In addition much supplementary information was obtained, most of which is given in this report. Clearly a social survey cannot provide all that is needed for an overall economic assessment. Although it measures the amount of absenteeism after a raid, it gives no indication of the extent to which the efficiency of workers returning to work is reduced, nor does it measure the results of damage to factories, except in so far as this leads to absenteeism. These defects have been, however, remedied in part by using information directly obtained from the factories.

The surveys have provided an opportunity for collecting material on movements of labour and changes of employment. It has also been thought worth while to discuss in some detail the methods used, to examine the reliability of the data where alternative sources of information were available, and in some cases to compare results obtained by different interviewers. Although the objectives of the survey were limited it is hoped that it will be of value as indicating the type of question from which precise information can be obtained, and of the kind of examination needed to establish reliable results.

2. METHOD

2.1 Introduction

The decision to investigate the effects of air attack by a social survey based on house-to-house visits raised at once the question of the choice of a sample. The material collected would have to be representative of the towns as a whole, and would therefore need, as a basis, random samples of sufficient size to give reliable answers to the questions:

(a) how much time was lost from work by workers as a result of raids,

and (b) what movements of population followed the raids.

Further, since the distribution of bombs might be so uneven that the samples chosen would contain too few workers from the heavily bombed areas, it was realized that it might, on occasion, be necessary to take a larger sample from certain parts of the towns. This was done for York.

It was decided to take a random sample of the houses in each town, and at each house interviewers completed questionnaires relating to the families present at the time of the raids. Needless to say there were many changes in the composition of the town populations between the raids and the surveys, and frequently it was necessary to trace the original occupants of the houses in the sample.

2.2 Selection of a random sample of houses

From the total number of houses as given by the Local Authority a fraction was estimated which would give a sample of the size required. In the first town, Norwich, with 36,650 houses, one in every 75 was taken, giving a sample of 469. This proved to be about the right number, and in other towns an adjustment of the fraction was made according to the size of each town.

In England the sample was taken from the electoral register, and in Scotland from the valuation roll. In the latter, although the names of the occupants are given, it is the dwelling which is numbered, and not the occupants as in the electoral register.

With the electoral register, the method followed was to examine every 75th, 100th (or whatever unit was chosen, depending on the size of the sample required) entry. If this entry referred to the first name in a house, that of the occupier, then that house was selected. If it referred to the second or subsequent name, the house was rejected. In the case of blocks of flats, houses subdivided into flats, etc., an entry was considered as referring to a different dwelling unit if there was a difference in the address (such as the addition of a letter after the street number). Using the valuation roll, however, every 75th, 100th, etc. entry was taken with no rejections.

In order to ensure that a proper sample was taken from dwelling units, which for one reason or another were omitted from the electoral register, the street number of the dwelling unit in the register immediately following the one selected for the sample, was noted. If when the selected number was visited it was found that there was an intermediate number between the selected number and the following one on the electoral list, then this was also visited. In registers which record the successive houses on one side of a street containing only

odd or even numbers, this rule would be taken as applying only to the odd or even numbers respectively. Thus, for example, if house 17 was selected for the sample and the next number in the register was 21 (odd numbers only), house 19 would also be visited if it were found to exist.

This method of sampling from the electoral register gives a completely unbiased sample which will on the average contain the correct fraction of houses. The actual number of houses included however will be subject to chance fluctuations depending on the number of inspected entries which happen to refer to the first member of a household. This fluctuation will contribute appreciably to the sampling error of estimates, such as that of the total population, which are obtained by multiplying the total number in the sample by the sampling fraction. More precise estimates could be obtained either by examining the register in detail and counting every 75th, 100th etc. dwelling unit, or alternatively if this would introduce too great a delay, by adjusting the sampling fraction subsequent to the actual sampling. In the present investigation, however, precise estimates of the above type were not required and consequently no adjustment of the sampling fraction was made.

It is evident that estimates of population based on a survey of dwelling units alone will be low, since persons in hotels, boarding houses, institutions, hospitals, etc., are excluded. The population figures available from the Registrar General's return are not sufficiently reliable for the period of the war to show the extent of such exclusions. In his study of York which was based on the survey of dwellings *Rowntree estimated the numbers excluded on this basis as 7,840 out of a working class population of 63,046. They were divided as follows:-

Domestic servants	4,300
Hospitals	579
Poor law institutions and vagrants	661
Working class schools and orphanages	200
Naval, military and air force premises	2,100
Total	7,840

This total corresponds to 12% of the working class population.

In the present survey domestic servants are included, so the corresponding omissions are 3,540 (5½%) or 1,440 (2½%) if service personnel are excluded from the total. Although the position varies from town to town these figures give some idea of the extent to which a house survey underestimates the total population.

The information in the electoral register usually made it possible to exclude premises entered there because of a business qualification, but some cases about which there was doubt were included when the sample was prepared. A few houses had become dilapidated and were no longer occupied, or had been pulled down since the register was made. Institutions, hospitals, orphanages etc., were usually evident in the register, but occasionally boarding-houses or non-residential shops were not recognized as such and had to be eliminated. As soon as the field visit was made the nature of these entries was clear, and they were then referred to as "unproductive visits".

The sample having been selected, interviewers were provided with lists of the houses they were to visit. Since the survey was concerned with the people living in the houses at the time of the raids, an attempt was made to trace the original household in the event of its having removed, and interviewers became very skilful at using supplementary sources of information (the Food Office, Post Office, schools, estate agents, etc.) which could help in locating the original occupants. In cases which could not be traced it was sometimes possible to obtain the information required from neighbours or relatives, but

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* "Poverty and Progress" by B.S. Rowntree, Longmans, Green, 1941, p.12.

in others where the data were not available, inadequate or judged to be unreliable, the household was entered as "untraced". Not in any case was a neighbouring house substituted for the one in the sample, a procedure which introduces an error into any random sample, and a serious one into an enquiry such as the present where the families most affected by raids were often the most difficult to trace.

Table 1 summarises the facts concerning the samples used in the various surveys. It will be seen that the number of untraced households is not large enough to introduce any serious error.

2.3 Collection and tabulation of data

With the help of the person interviewed, generally a housewife, field-workers completed during the visit one form for each household in the sample. The type of interview form used varied slightly from one town to another, but the basic information obtained was the same in all. A specimen of the form used in Birmingham, with the nature of the data entered under the different headings, is illustrated in Fig. 20, and described in Appendix II. The form lists the various members of the household and gives their relationship to one another, their occupations and places of employment, their movements following the raid and any loss of working time and the reasons for it.

In most of the towns studied punched cards were prepared, one for each worker in the sample from the information on the interview forms. A specimen punched card is illustrated in Fig. 21 and the method of preparing the card is given in Appendix III. These cards were readily sorted and classified by arranging them in a pack, passing a knitting needle through a particular hole, lifting the pack by the needle and shaking vigorously. The cards punched in this hole then fall out.

2.4 Tracing the pre-raid population

Since the survey was concerned with the effects of the raids on the people who were living in the town at the time (loosely termed "the pre-raid population"), it became necessary to trace the residents of the houses in the sample where these had removed to new dwellings. Periods varying from 3 weeks to 2½ years had elapsed between the raids and the date of the survey and it was essential to get a check on the accuracy of the methods used. For this purpose two alternative methods were used in Coventry and a comparison made between the results obtained.

The persons resident in the houses in the sample at the time of the raids may be divided into four groups (excluding those who were killed or who had died) on the basis of their location at the time of the survey.

A. Those living in the same house.
B. Those living elsewhere in the town.
C. Those living outside and near the town.
D. Those living outside and far from the town.

The distinction between C and D is discussed later under population movements. The workers of C group were able to continue with their original work, while those in D gave it up. It was possible to trace those in C, but for residents of group D it was necessary to depend on information supplied by relatives or neighbours. These four groups are represented diagrammatically in Fig. 1(A).

The method used in all the towns was to trace the original occupants of the houses in the sample, accepting the loss of the comparatively few households which were returned "untraced" (see Table 1). An alternative possibility was to consider the people resident in the houses in the sample at the time of the survey. These can be divided into three groups on the basis of their location at the time of the raids.

TABLE 1

The sample - House-to-house visits

Survey data	Birmingham	Bootle	Canterbury I	Canterbury II	Clydebank	Coventry	Exeter	Greenock	Grimsby	Norwich I	Norwich II	Plymouth	York
Sampling fraction proposed	1/250	1/30	1/25	1/15	1/20	1/90	1/50	1/33⅓ 1/40+ 1/200-	1/50	1/75	1/75	1/70	1/75
No. of houses in sample	1401	537	290	470	623	740	389	580	510	496	510	595	386
*No. of unproductive visits	64	23	15	53	31	25	6	37	19	16	30	17	10
No. of productive visits	1337	514	275	417	592	715	383	543	491	480	480	578	376
No. of untraced households	39	17	6	0	38	16	1	12	0	11	8	22	1
Size of sample after subtracting untraced households	1298	497	269	417	554	699	382	531	491	469	472	556	375
Sampling fraction actually used	1/257.5	1/31	1/25.6	1/15	1/21.4	1/92.1	1/50.1	1/34.1	1/50	1/76.8	1/76.3	1/72.8	1/75.2
No. of houses (estimated from survey)	334200	15400	6900	6300	11800	64300	19100	18100	24500	36000	36000	40500	28900
No. of houses (estimated by local authorities)	330000	16200	7100	6100	12000	66100	18800	18400	24500	36600	36600	42000	26800

* Unproductive visits: Boarding houses, non-residential shops etc., eliminated from the sample after the field visit.

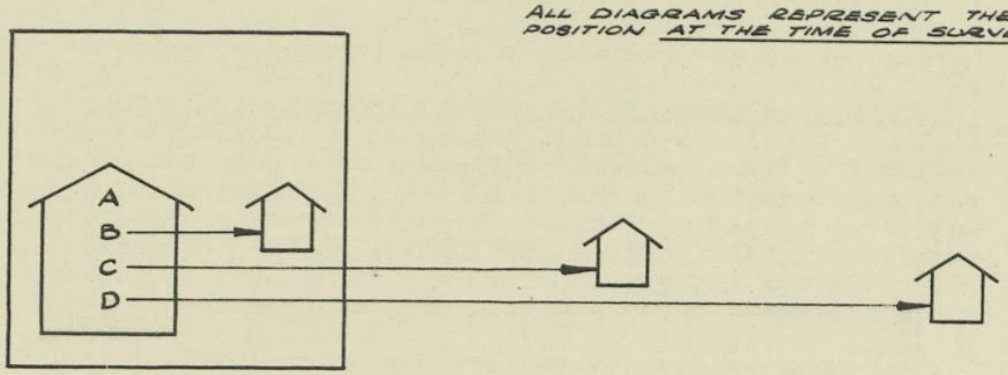
Two surveys were made at both Canterbury and Norwich.

FIGURE . 1 .

TRACING THE PRE-RAID POPULATION.

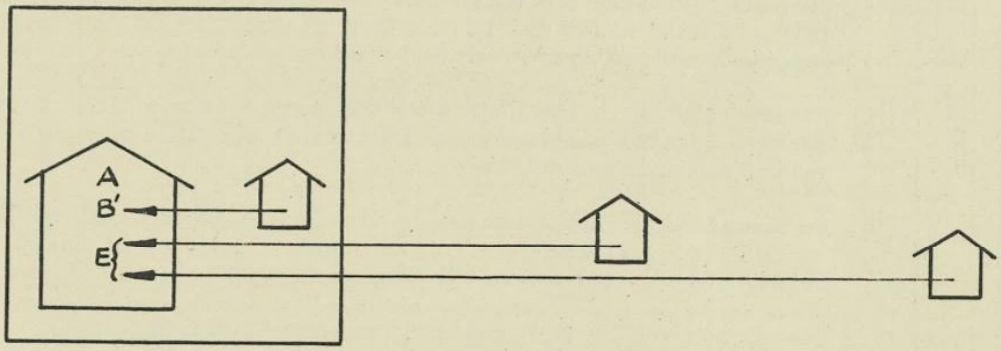
(SEE SECTION 2.3)

ALL DIAGRAMS REPRESENT THE POSITION AT THE TIME OF SURVEY.



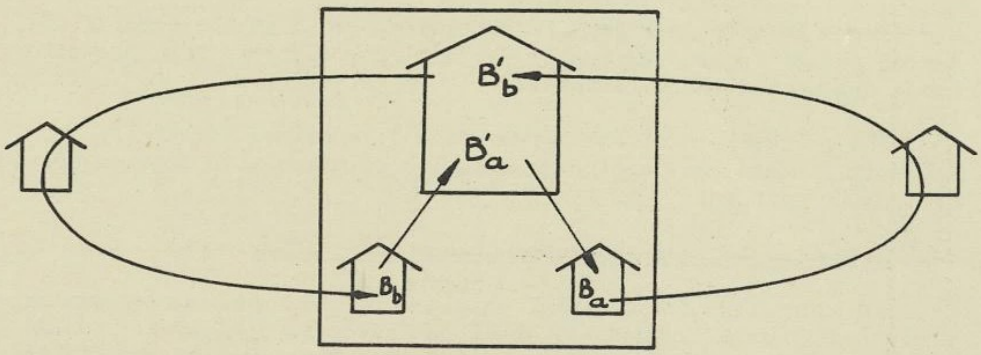
HOUSE IN THE SAMPLE. | ELSEWHERE IN THE TOWN. | WITHIN DAILY REACH. | BEYOND DAILY REACH.

(A)



HOUSE IN THE SAMPLE. | ELSEWHERE IN THE TOWN. | WITHIN DAILY REACH. | BEYOND DAILY REACH.

(B)



HOUSE IN THE SAMPLE.

TEMPORARY EVACUATION. | ELSEWHERE IN THE TOWN. | ELSEWHERE IN THE TOWN. | TEMPORARY EVACUATION.

(C)

A. Those living in the same house.
B^1. Those living elsewhere in the town.
E. New arrivals, not resident in the town at the time of the raids.

These three groups are represented diagrammatically in Fig. 1(B). Group A is the same in both series, group B^1 is equivalent to B but it could be investigated without the necessity for tracing with its difficulties and consequent inaccuracies. Group E, the new arrivals, are not part of the pre-raid population. The deficiency of the method is, of course, that C and D groups are not covered, and for this reason this method, easier and more accurate, was used only in Coventry in addition to, and as a check on, the results of the usual procedure.

The comparison which can most usefully be made for the two methods is between groups B and B^1, i.e. between those living in the sample houses at the time of the raids but living elsewhere in the town at the time of survey and those living elsewhere in the town at the time of the raids but living in the sample houses at the time of the survey. They can be further subdivided, according to whether or not they had evacuated at some time during the period. In this way we get four groups:

B(a) Persons living in the houses in the sample at the time of the raids, located elsewhere in the town at the time of the survey, and who had not evacuated.

B(b) Persons living in the houses in the sample at the time of the raid, located elsewhere in the town at the time of the survey, and who had evacuated temporarily.

B^1(a) Persons living in the houses in the sample at the time of the survey, located elsewhere in the town at the time of the raids, and who had not evacuated.

B^1(b) Persons living in the houses in the sample at the time of the survey, located elsewhere in the town at the time of the raids, and who had evacuated temporarily.

These four sub-groups are represented diagrammatically in Fig. 1(C).

Table 2 compares the results obtained by using the two methods in the Coventry survey to determine the industrial and occupational distribution of the workers, the working time lost in the three weeks following raids and the percentage evacuating from the town after the raids. All of these figures refer to workers only. It will be seen that there is fairly close correspondence between the percentages given for the B and B^1 method for parts A and B of the Table. Part C also shows very little difference in the figures for the two methods. In Part D the movements of workers, while not corresponding closely are generally consistent.

There is therefore good reason to believe that the results obtained in tracing those persons who had removed from their pre-raid house are on the whole reliable.

The reliability of the survey data is examined more fully in Appendix V where some of the results are compared with figures provided from other sources.

2.5 Data from sources other than the social survey

In every town the material obtained in the field survey was supplemented by data provided by the local authority, by local industry, and by government departments, and the investigators are greatly indebted to all of them for their consideration and help. The local authorities not only facilitated the survey in their towns, but provided access to records of housing, house damage, costs of repair, population, casualties, labour employed on repairs, damage to public utilities, evacuation schemes, emergency feeding and many others. The

Ministry of Labour provided data on local industry, figures for the labour force employed by various firms and records of certain general effects of the raids on labour. Extensive help given by local employers has been used in other parts of this investigation, but the only records discussed at length in the present report were provided by the Norwich Shoe Industry, Singer's Manufacturing Co. Ltd., Clydebank, and the Port of Liverpool Authority. In general, private employers gave all the help they could and the difficulty was usually that suitable records were not kept rather than that access was denied to them.

TABLE 2

Coventry - Comparison of the results of the two methods of tracing pre-raid population

A. Industrial distribution of workers

	Engineering		Other war industry		Other industry		Transport		Distributive trades		Government service		Miscellaneous		Unknown	
	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1
a	101	119	21	25	3	2	-	3	32	28	11	12	3	5	8	12
b	39	30	3	6	1	2	-	-	8	6	4	7	-	1	-	1
Total	140	149	24	31	4	4	-	3	40	34	15	19	3	6	8	13
%	60	58	10	12	2	2	-	1	17	13	7	7	1	2	3	5

B. Occupational distribution of workers

	Administrative & professional		Clerk		Foreman		Skilled worker		Unskilled worker		Owner of small business		Shop assistant		Unknown	
	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1
a	3	-	17	26	5	1	51	68	78	90	10	4	7	7	8	10
b	1	1	6	7	-	3	12	20	31	19	3	2	2	-	-	1
Total	4	1	23	33	5	4	63	88	109	109	13	6	9	7	8	11
%	2	-	9	13	2	2	27	34	47	42	6	2	4	3	3	4

The four groups B_a, B_b, B^1_a and B^1_b are defined in section 2.4.

TABLE 2 (contd.)

C. Time lost by workers in first three weeks after the raids

Group	Number of workers		% Female		% losing time from work		Days lost per absentee		Days lost per worker	
	B	B^1	B	B^1	B	B^1	B	B^1	B	B^1
a	179	206	30	34	59	61	7.5	6.6	4.4	4.0
b	55	53	42	27	75	74	9.4	9.4	7.1	7.0

D. Movements of workers

Group	Weeks after the raids	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
B(b)	% evacuated	71	63	55	55	50	49	41	41	38	35	33	39	29	29	29	29	23	23	26	41	41	43	39	39
B (b)	% evacuated	72	66	60	58	54	54	44	44	46	46	46	46	42	40	40	36	36	36	36	50	48	48	48	48

N.B. Weeks are counted from the date of the first raid on Coventry on 14/15th November 1940 and it will be noticed that 20 weeks later the attacks on 8/11th April 1941 caused a sharp rise in the percentage evacuated but to a much lower level than after the first raid.

For explanation see section 2.4.

3. THE SURVEY TOWNS AND THE WEIGHT OF ATTACK

3.1 Introduction

Survey work began in May, 1942, and the first towns* studied were Norwich, York, Canterbury and Exeter, the "Baedeker" towns which had been recently raided. The choice was made not so much because they were ideal for the purpose - Canterbury, for example, with but few industrial workers, was not - as because the raids were recent and their effects could be expected to be fresh in people's minds. A second Norwich survey in September, 1942, was intended not only to cover the later raids but to discover for how long after a raid reliable information could be collected. Encouraged by the consistency of the results a survey of Bootle (raided about eighteen months before the survey which was made in November, 1942) was included in an investigation of the economic effects of the raids on the Port of Liverpool, and a survey of Clydebank and Greenock was included in a similar investigation in Clydeside. Coventry and Birmingham were chosen generally for their economic importance, and particularly because of their high proportion of factory workers. The remaining surveys, Plymouth, Grimsby and a second in Canterbury, were made because the raids on these cities exhibited features not covered by other surveys.

One obvious omission is London, which it was decided not to survey for two reasons. The first was that the raids extended over such a long period that reliable answers could not be expected to questions about time lost from work, and the second that London is so large that with the uneven distribution of bombs special difficulties would be raised in sampling. In any case results obtained in a large area like London could not strictly have been compared with those from the more compact centres which form the chief subjects of the study.

Table 3 gives details of area and population of the towns which were studied. There are great differences in the economic importance of these towns. Birmingham and Coventry are large industrial centres with 62% and 71% respectively of industrial workers. Clydebank and Greenock have a high proportion of workers employed in the shipbuilding and related industries. Bootle with 54% of factory workers is also important industrially, and many of its workers are dockers in the Port of Liverpool. None of the Baedeker towns - Norwich, York, Exeter and Canterbury - is of first-rate industrial importance, although Norwich and York have 33% of factory workers and York is also a railway centre, with a large carriage works. Plymouth and Grimsby have 35% and 38% respectively of industrial workers; in Plymouth many of them are employed in the dockyards, and in Grimsby in the fishing industry.

Tables 4 and 5 give the occupational and industrial distribution of the workers in the towns covered by the survey.

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* In this report the nouns "town" and "city" are used as synonymous terms and carry no technical implications.

TABLE 3

Areas and populations of the towns

Town	Administrative area (sq.mls.)	Population			% workers	% industrial workers of total workers
		Immediate pre-raid total	Per sq. mile of administrative area	Per sq. mile of zoned area[1]		
Birmingham	79.92	1,099,500	13,700	29,100	49	62
Bootle	3.75	50,500	13,500	16,700	45	54
Canterbury	7.29	18,800	2,600	12,400	42	10
Clydebank	3.67	41,900	11,400	21,900	46	72
Coventry	29.95	184,400	6,200	13,600	54	71
Exeter	7.31	60,900	8,300	15,700	40	15
Greenock	5.07	71,100	14,000	21,700	41	58
Grimsby	8.54	75,000	8,800	15,000	39	38
Norwich	12.36	103,600	8,400	19,700	43	33
Plymouth	14.8	161,300	10,900	18,800	38	35
York	10.09	88,300	8,700	18,800	45	33

1. The method of zoning is described in 3.2. Populations are those estimated from the survey results and do not include people in institutions, hotels and the like.

2. "Industrial workers" are defined in Appendix IV and exclude those engaged in transport, distributive trades, government service and miscellaneous occupations.

3.2 Estimation of the weight of attack

For most of the towns covered by the survey a bomb census was made by the technical staff of the Research and Experiments Department which attempted to locate the position of the H.E. bombs and to estimate their weight. The bomb census was not available for some of the earlier raids, and only rough estimates were obtained for Bootle, Clydebank, Greenock and Coventry and for the 1941 raids on Plymouth.

All of these estimates were of H.E. bombs only; in some cases an attempt to count incendiary bombs was made, in others only the larger incendiary bombs were included and in others again they were not recorded at all. Examination of the figures for the proportion of incendiary bombs loaded onto German aircraft during the periods in question gives an average of 6% for I.B. for 1940, 7% for 1941, 11% for 1942 and 18% for 1943. These figures indicate the probable weight of incendiary bombs that was dropped in addition to the weights of H.E. recorded in Table 9.

There is again considerable discrepancy in certain cases between the estimates given in Table 9 and determinations made later. Conclusions cannot be drawn, therefore, from a specific attack on the basis of effective density alone, but only when all the indices agree as to its effectiveness.

3.3 Indices of the weight and effectiveness of attack

In assessing the weight and effectiveness of attack four indices have been considered:

(1) Casualties,
(2) Percentage of houses destroyed,
(3) Percentage of all buildings destroyed, and
(4) Weight of high explosive dropped, expressed as "effective density".*

* The ratio of "effective tonnage" to "effective city areas". These are defined at the end of section 3.3.

TABLE 4

Percentage of workers employed in different industries

Industrial Group	Clydebank March 1941 %	Bootle May 1941 %	Canterbury June 1942 %	Plymouth March 1941 %	Exeter April 1942 %	Norwich April 1942 %	Greenock May 1941 %	Coventry November 1940 %	Birmingham November 1940 %	York April 1942 %	Grimsby June 1943 %
Industry	72	54	10	35	15	33	58	71	62	33	38
Transport	2	2	5	5	10	6	6	1	4	18	12
Distributive trades	15	17	39	27	29	25	20	15	20	19	27
Government Service	11	12	22	16	19	11	14	8	8	12	14
Miscellaneous		10	24	7	27	25		3	5	18	7
Forces	0	0	0	9	0	0	2	0	0	0	2
Unemployed	0	1	0	0	0	0	0	0	0	0	0
Unknown	0	4	0	1	0	0	0	2	1	0	0
Total	100	100	100	100	100	100	100	100	100	100	100
No. of workers	897	726	306	839	483	585	855	1077	2087	521	578

TABLE 5

The percentage of workers employed in different occupations

Occupation	Clydebank March 1941 %	Bootle May 1941 %	Plymouth March 1941 %	Greenock May 1941 %	Coventry November 1940 %	Birmingham November 1940 %	Grimsby June 1943 %
Administrative and professional	3	1	3	4	3	3	3
Clerical	7	11	10	7	10	13	12
Foreman	2	3	3	1	4	3	2
Skilled labourer	56	12	22	45	31	20	11
Unskilled labourer	24	57	34	32	42	49	54
Owners of small businesses	3	3	8	3	5	7	10
Shop assistants	5	9	9	6	3	5	6
Forces	0	0	9	2	0	0	2
Unemployed	0	1	0	0	0	0	0
Unknown	0	3	2	0	2	0	0
Total	100	100	100	100	100	100	100
No. of workers	897	726	839	855	1077	2087	578

In all towns figures for the casualties (killed and seriously injured) were readily available. Unfortunately little significance can be attached to the numbers of seriously injured because the method of recording the injured varies from town to town. In most towns all hospital cases are shown as serious; but persons who have only slight injuries are admitted to some hospitals and may therefore be entered as serious. For this reason only the numbers of killed have been used, expressed as killed per thousand of the pre-raid population. The only objection to this procedure is that where considerable numbers of people evacuated or trekked after a first raid as in Clydebank, the number exposed to risk is considerably reduced on subsequent nights.

For house damage the numbers demolished (A damage) or so seriously damaged as to require demolition (B damage) can be determined accurately, but the figures for less severe damage are unreliable. The percentages of houses in A and B categories only, are therefore used. In some towns the percentages of buildings which suffered A or B damage were taken from ground surveys of damage. In others where these were not made estimates have been made from the best data available.

The weight of H.E. attack is commonly represented in terms of metric tons[1] per square mile reckoned over the administrative area of the town or borough concerned. The density over the whole of the area of the town, however, is often very uneven, and the average density will, therefore, fail to distinguish between raids concentrated on the built-up areas and those where much of the attack has been wasted on the suburbs and open spaces within the administrative area. Moreover the figures for different towns with different amounts of open country within their administrative areas will not be comparable. If, for example, attacks of the same total weight are made on two towns of the same size and all the bombs fall on the built-up areas, the attacks may be expected to be similar in their effects; but if the administrative area of one town (owing to the inclusion of open country) is double that of the other the densities in metric tons per square mile will be in the ratio 1 : 2.

The towns considered have been roughly divided into zones as follows:-

Zone 1

Old City Centre	Land fully occupied by buildings, chiefly commercial premises.

Zone 2a

Inner Residential	Land (approximately 70%) occupied by buildings, chiefly commercial and public buildings and closely-packed terraced houses. Contains the main shopping streets.

Zone 2b

Intermediate Residential	Land (approximately 50%) occupied by buildings, chiefly terraced houses and some commercial property. Contains smaller shopping streets, open spaces and small parks.

Zone 3

Suburban Residential	Land (approximately 30%) occupied by chiefly modern detached and semi-detached houses. Contains larger park land, wider roads and gardens and little commercial property.

1. A metric ton (or tonne) = 2,200 lb.

Zone 4

Industrial	Large and small factory sites and associated open spaces.

Zone 5

Railway and/or Docks	Railway buildings, workshops, wharves, warehouses, railway tracks and waterways.

In some towns a sixth zone is necessary for that part of the industrial area which contains a proportion of houses.

Unzoned	The unzoned areas consist of the large open spaces lying between the other zones and the outer rural areas which are within the city's administrative boundary.

Within any zone the following characteristics are either constant or vary only slightly from part to part:

a) Structural type and occupancy of buildings (including height).
b) Density of population.
c) Builtupness (here meaning the proportion of area covered by roofs).
d) Social class of population.

In order to obtain an index of the "effective density" on a town, "effective tonnages" were calculated by giving unit weight to bombs falling in zones 1, 2a, 2b, 4 and 5, and half weight to those falling in zone 3, these weights being roughly proportional to the densities of population in these zones. Bombs falling in the unzoned areas were excluded entirely. "Effective city areas" were also calculated, using the same weighting system. The ratio of these two quantities gives the "effective density". It should be noted that the effective density will be equal to the density over the administrative area when the bombing has a constant density over the whole of the area.

In four towns, Bootle, Coventry, Plymouth and Grimsby, no bomb plots by zones were made and the effective densities have been estimated.

3.4 Bombs falling outside the administrative areas and in the unzoned areas

Estimates of the percentage of bombs falling outside the administrative areas are shown in Table 6 for those towns in which the figures are available. It will be seen that about 41% of the total weight of bombs was lost in this way.

TABLE 6

Bombs falling outside the administrative areas

Survey	Norwich 1	Norwich 4	York	Canterbury 1	Exeter 1	Exeter 2	Plymouth 3	Grimsby 2	Total
Weight of bombs falling in the administrative area (m. tons)	96	18	49	50	25	51	17	27	333
Weight of bombs falling outside administrative area (m. tons)	5	72	23	40	54	17	15	6	232
% weight of bombs falling outside administrative area	5	80	32	40	68	25	47	18	41

The numbers immediately under the names of the towns indicate the raid in numerical order for each town for which figures are given. See Table 8.

Table 7 gives the densities of bombing in different zones of the Baedeker towns.

TABLE 7

Average densities of bombing in different zones of the Baedeker towns (metric tons per sq. mile)

Raid zones	Exeter		Norwich	Canterbury		York
	1	2	1	1	2	
1, 2a, 2b	6.0	22.0	15.3	20.3	10.1	8.7
3	4.7	8.0	11.7	11.4	7.0	4.1
4, 5	3.5	8.7	11.5	8.0	1.4	12.8
Unzoned	1.8	1.8	4.0	4.7	1.5	3.1
Administrative area	3.4	7.0	7.8	8.2	2.7	4.9

All the attacks on the Baedeker towns were successfully concentrated on the centres of the cities. Nevertheless a considerable proportion of the total bomb weight was in fact wasted on the unzoned areas, the percentages being:-

Exeter.	Raid 1	24%	Canterbury.	Raid 1	54%
"	" 2	12%	"	" 2	44%
Norwich.	" 1	29%	York		32%
"	Raids 2-4	38%			

These figures do not include bombs falling outside the city boundaries.

3.5 The raids

Tables 8 and 9 give particulars of the raids on the towns covered by the survey. For the purposes of analysis, raids occurring on consecutive nights or at intervals of two or three days have been grouped together, since it is obviously not possible to subdivide the effects on labour. It will be seen from the tables that many different types and intensities of raiding have occurred. Heaviest in effective density of high explosive were the two raids on Clydebank on consecutive nights which destroyed a third of all its houses. Bootle suffered the next heaviest series of attacks, and here the raids extended over 8 nights. Canterbury had a fairly heavy night raid followed by two lighter ones, and after an interval of 5 months a single sharp daylight attack. Greenock was hardly affected by the earlier Clydeside raids, but had two attacks of moderate intensity on consecutive nights. In Norwich there were raids at intervals during the summer of 1942 which included the fire raids of June 26/27 and August 1/2. Exeter had several attacks; that of May 3/4, 1942, was the heaviest in weight of high explosive dropped but the earlier one on April 24/25 was responsible for extensive fire damage to the city centre. Plymouth also suffered widespread damage from fire in March and April, 1941, and was again raided, though not heavily, in June 1943. To many people it will come as a surprise to learn that the raids on Coventry, the first and best known of the major attacks, were by no means the heaviest. There had been earlier small raids but that in November, 1940, was the most severe and caused widespread damage to the city centre and there was further raiding in April 1941. York, another of the Baedeker towns, had a single raid in April 1942. Like Coventry, Birmingham was attacked over a considerable period, but the weights when related to the size of the town were not heavy. Grimsby had earlier minor raids and in June, 1943, a considerable number of incendiaries and of anti-personnel bombs were dropped on the town. There was a further raid on the town in July mainly of high explosive bombs which fell in the dock area.

The effective densities for the towns covered by the survey are plotted against fatal casualties per 1,000 population in Fig. 2 and against percentage of houses demolished in Fig. 3. It will be seen that although there are wide variations for individual attacks, there is a general linear relationship in both cases.

TABLE 8

Dates of raids and casualties

Town	Ref.	Raid		No. of casualties		
		Date	Day of week	Killed	Seriously injured	Killed per 1,000 population
Clydebank	Cl.	13/14 March '41 14/15 March '41	Thurs./Fri. Fri./Sat.	528	617	12.6
Bootle	Bo.	1/2 to 8/9 May '41	Thurs. to Friday week	262	261	5.2
Canterbury	Ca.1	31 May/1 June '42 2/3 June '42 6/7 June '42	Sun./Mon. Tues./Wed. Sat./Sun.	48	57	2.6
	Ca.2	31 Oct./1 Nov.'42	Sat./Sun.	31	47	1.9
Plymouth	P.1	20/21 March '41 21/22 March '41	Thurs./Fri. Fri./Sat.	328	279	1.9
	P.2	21/22 April '41 22/23 " '41 23/24 " '41 28/29 " '41 29/30 " '41	Mon./Tues. Tues./Wed. Wed./Thurs. Mon./Tues. Tues./Wed.	590	430	3.4
	P.3	12/13 June '43	Sat./Sun.	13	37	0.1
Exeter	E.1	23/24 April '42 24/25 " '42 25/26 " '42	Thurs./Fri. Fri./Sat. Sat./Sun.	88	58	1.5
	E.2	3/4 May '42	Sun./Mon.	174	131	2.9
Norwich	N.1	27/28 April '42 29/30 " '42	Mon./Tues. Wed./Thurs.	223	254	2.2
	N.2	26/27 June '42	Fri./Sat.	14	11	0.1
	N.3	1/2 August '42	Sat./Sun.	-	-	0
	N.4	Small raids May -	Sept. '42	-	20	0
Greenock	G.	5/6 May '41 6/7 May '41	Mon./Tues. Tues./Wed.	297	289	4.2
Coventry	Cov.1	14/15 Nov. '40	Thurs./Fri.	568	863	3.1
	Cov.2	8/9 April '41 9/10 " '41 10/11 " '41	Tues./Wed. Wed./Thurs. Thurs./Fri.	474	702	2.6
Birmingham	Bir.1	19/20 Nov. '40 20/21 " " 21/22 " " 23/24 " "	Tues./Wed. Wed./Thur. Thurs./Fri. Fri./Sat.	683	1124	C.6
	Bir.2	11/12 Dec. '40	Wed./Thurs.	263	245	0.2
	Bir.3	9/10 April '41 10/11 " '41	Wed./Thurs. Thurs./Fri.	410	373	0.4
York	Y.	28/29 April '42	Tues./Wed.	76	93	0.9
Grimsby	Gri.1	13/14 June '43	Sun./Mon.	61	80	0.8
	Gri.2	12/13 July '43	Mon./Tues.	45	98	0.6

TABLE 9

Weight and density of attack and material damage

Town	Ref.	Weight of attack (m. tons)	Density of attack (m. tons per sq. mile)		Material Damage		
			Administrative area	Effective density	% building destroyed	Houses Demolished %	Houses Demolished % of damage due to fire
Clydebank	Cl.	150	41	(60.2)	(27)	33	59
Bootle	Bo.	103	28	(38.0)	(11)	8.1	24
Canterbury	Ca.1	50	6.9	16.5	(10)	8.0	38
	Ca.2	20	2.7	7.7		1.5	
Plymouth	P.1	56	3.8	(9.3)	(4.1)	3.5	56
	P.2	158	10.7	(12.5)	(5.2)	4.7	
	P.3	17	1.2	-	(0)	0.2	0
Exeter	E.1	25	3.4	5.0	9.8	5.8	60
	E.2	51	7.0	13.2			
Norwich	N.1	96	7.8	13.3	4.6	4.8	25
	N.2	1½	0.1	0			
	N.3	1	0.1	0.3	4.1	0.3	
	N.4	18	1.5	2.3			
Greenock	G.	51	10	(14.9)	(7)	5.2	51
Coventry	Cov.1	200-250	7.5	(9.1)	(4.0)	3.5	20
	Cov.2	112	3.7	(5.1)	(2.5)	1.9	9
Birmingham	Bir.1	158	1.5	4.2	(0.7)	0.6	
	Bir.2	68	0.7	1.7	(0.1)	0.1	
	Bir.3	134	1.3	3.2	(0.3)	0.2	
York	Y.	49	4.9	8.2	0.7	0.7	14
Grimsby	Gri.1	6	0.7	(0.8)	(0.3)	0.3	0
	Gri.2	27	3.2	(3.5)	(1.5)	1.3	0

Figures in brackets are based on estimates.

CASUALTIES AND HOUSE DAMAGE RELATED TO DENSITY OF ATTACK.

FOR MEANING OF SYMBOLS SEE TABLE 8.

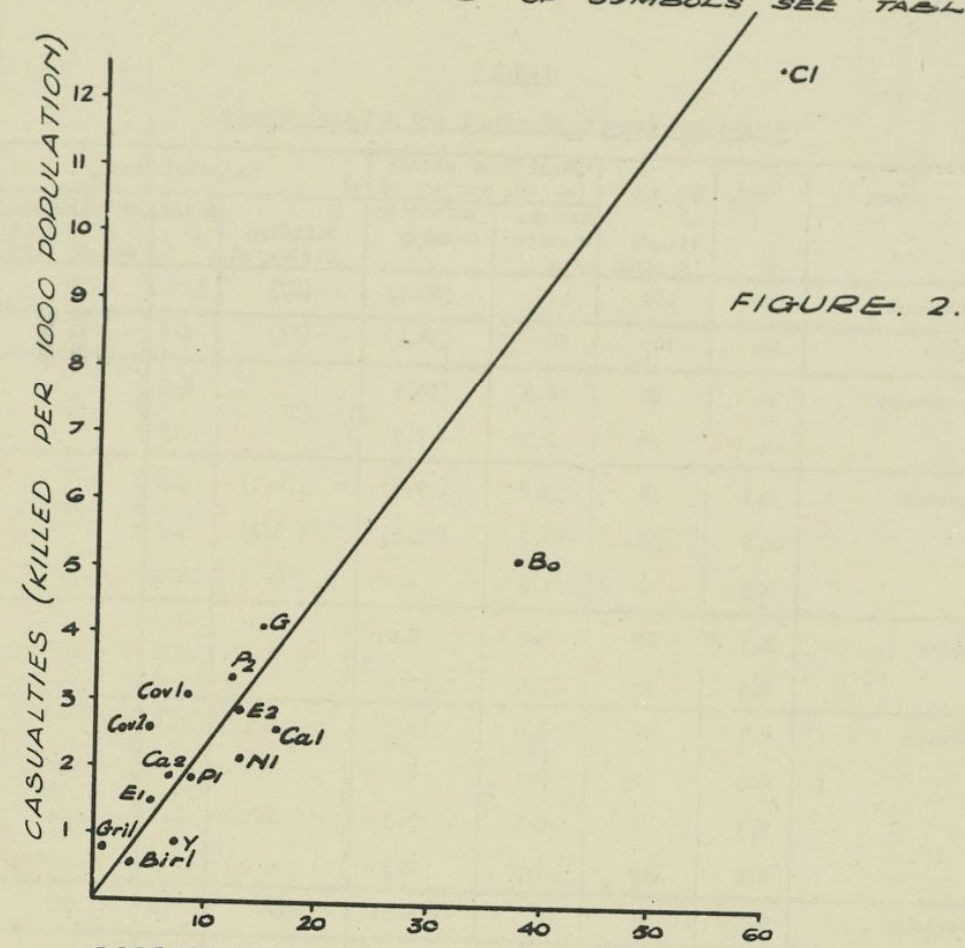

FIGURE. 2.

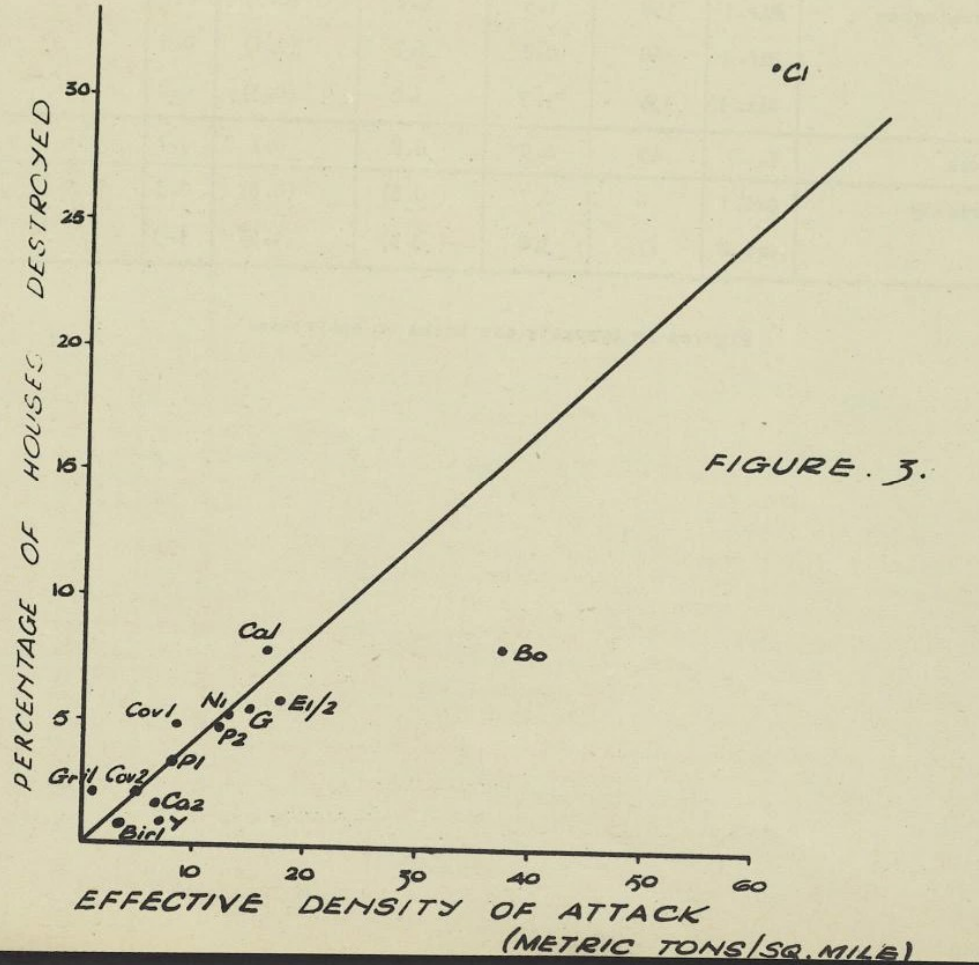

FIGURE. 3.

4. MOVEMENTS OF POPULATION

4.1 Introduction

The extent of the movements of the population which would result from air raids or the threat of air raids could only be guessed. The Anderson report of July 1938 on evacuation having been accepted in principle by the Government, "priority classes" were moved from evacuation to reception areas immediately before and on the outbreak of war. In addition to the organised scheme, individual persons and business offices made their own arrangements for moving from the evacuation areas and did so in their own time. In some towns in which the survey was made it was evident that a small number of houses had been evacuated before serious raiding began.

In all the towns included in the survey heavy raids were followed by evacuation and trekking*. The percentages vary considerably, but as the data show are correlated with the weight of attack. Two other factors which would be expected to influence the movements are the adequacy of the shelter accommodation available and the morale of the people. Such material as is available (see Chapter 6) does not suggest that there were striking differences in the morale of the British towns which were raided, but the adequacy of shelter provision was undoubtedly important. In London, for example, there were the tube stations which accommodated large numbers who could sleep in safety and adequate comfort and which by providing a safe night's rest caused many to remain who would otherwise have trekked or evacuated. Even so London was not entirely free of trekking and in the south-eastern boroughs, for example, some people travelled considerable distances to reach the Chislehurst Caves. But for most of the raided towns there were no such facilities. Hull had a special problem, as the city area is flat and a high water table makes the use of Anderson and similar sunken shelters very difficult.

Popular notions of safe shelter were curiously inconsistent. A building might be said to be unsafe because it had been hit once already, or safe because a bomb was unlikely to fall twice in the same place. Churches were used because they were considered to have divine protection, or avoided as the kind of target preferred by German airmen. It is not surprising that many people, particularly women and children, lacking faith in what shelter they had, either evacuated or took to the roads in the evening and made as best they could for the periphery of their city.

Official opinion on post-raid evacuation and trekking was cautious. Trekking in particular was considered to result from deterioration of morale, and it was feared that if facilities were provided the number of persons leaving would be increased. The view was expressed that it "should be made as difficult as possible" and "frowned on with displeasure". One government official stated that "if we encouraged trekking we should lose the war". It was not of course considered advisable to prevent anyone who wanted to leave from doing so, but in this case not to help was to hinder. In the early stages official arrangements were to be made to provide transport and accommodation for trekkers, but these lapsed and periodic examinations of identity cards on the roads by the police were a gentle reminder that leaving raided towns at night lacked official approval. It is of interest to compare these opinions with that of the psychiatrist whose summary

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* Trekking - a nightly movement from the congested areas to safer areas on the periphery or outside the town.

report is given in Appendix XII and who considered that trekking was an important factor in the recovery of persons living in the heavily bombed areas of Hull who developed neurosis.

In Hull the scenes at night when whole families took to the roads sometimes without transport, with no prospect of shelter except in fields, hedges, and piggeries were quite tragic. But in spite of these difficulties the situation was pleasanter for many people than that in the bombed town. An official report states in reference to some piggeries used for sleeping accommodation by trekkers "the people were bright and cheerful and thought the piggeries a satisfactory and even a pleasant place to sleep compared with Hull"*. Finally in Hull, as in other towns, limited facilities were provided and an attempt made to restrict their use to people whose homes were damaged and to women and children. But in practice it was impossible to enforce the distinction, and many a worker slept outside his town in the raiding period, and as the data show returned next day to do his work in spite of it. The report* by the Chief Warden of Hull of a visit to the piggeries referred to above gives some idea of the conditions in which trekkers slept.

4.2 Classification of movements

Population movements after raids are classified as follows:-

(i) Movements within the town. This includes persons who continue to live in the town, but who move to a new house.

(ii) Trekking. Persons sleeping outside the town, but returning to use their home during the day, are referred to as trekkers.

(iii) Evacuation. All those who take up new residences outside the town are considered to have evacuated. In some cases such people do not give up their old home to which they return at intervals. Evacuation is further subdivided into

(1) Evacuation to contiguous built-up areas,
(2) Evacuation to places within daily reach of the town, but separated from it by open country, and
(3) Evacuation to places not within daily reach.

This is an important distinction, since workers in the first two categories can continue with their pre-raid work, although those in the second category impose an increased burden on transport, while workers in the third group (3) must leave their original employment.

The separation of (1) and (2) is also important. Although, in the analysis, towns such as Clydebank and Bootle are considered as units, they are not strictly comparable with the other towns. They are administered separately, but are in fact continuous with the large neighbouring built-up areas of Glasgow and Liverpool. The loss of a third of the houses in Clydebank could not therefore strictly be compared to the same loss in Plymouth, where there is no adjoining built-up area capable of absorbing homeless persons.

It will be best to compare first the extent of the movements in the different towns covered by the survey. Table 10 gives the percentages evacuating, trekking and moving in the town, in relation to the four indices of weight of attack. These percentages are taken in each town for the day on which movements were at their height.

Table 10 shows that the greatest movements were in Clydebank, when 84% of the population evacuated after the two nights' raiding. The percentage trekking in this town (3%) was negligible. Considerable numbers also evacuated from Greenock (21%), Plymouth (19%), Coventry (16%) and Bootle (16%). The percentage of trekkers was greatest in Bootle (26%).

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* See Appendix XI.

TABLE 10

Material damage and movements of population

Town	Ref.	Effective density (m. ton sq. mile)	Casualties (killed per 1,000 population)	Material Damage			Movements				
				% buildings destroyed	Houses demolished %	% of damage due to fire	% remaining in the town	% trekking	% evacuating 1 & 2	% evacuating 3	Total
Clydebank	Cl.	(60.2)	12.6	(27)	33	59	13	3	80	4	100
Bootle	Bo.	(38.0)	5.2	(11)	8.1	24	58	26	12	4	100
Canterbury	Ca.1	16.5	2.6	(10)	8.0	38	66	23	11		100
	Ca.2	7.7	1.9		1.5		-	-	-		-
Plymouth	P.1	(9.3)	1.9	(4.1)	3.5	56	8		14	5	100
	P.2	(12.5)	3.4	(5.2)	4.7						
	P.3	0.0	0.1	0	0.2		100	0	0	0	100
Exeter	E.1	5.0	1.5	9.8	5.8	60	72	15	13		100
	E.2	13.2	2.9								
Norwich	N.1	13.3	2.2	4.6	4.8	25	80	12	8		100
	N.2	0.0	0.1								
	N.3	0.3	0.0	4.1	0.3						
	N.4	2.3	0.0								
Greenock	G.	(14.9)	4.2	(7)	5.2	51	74	5	18	3	100
Coventry	Cov.1	(9.1)	3.1	(4.0)	3.5	20	77	7	10	6	100
	Cov.2	(5.1)	2.6	(2.5)	1.9	9	-	-	-	-	-
Birmingham	Bir.1	4.2	0.6	(0.7)	0.6	0	95	1	3	1	100
	Bir.2	1.7	0.2	(0.1)	0.1	0	-	-	-	-	-
	Bir.3	3.2	0.4	(0.3)	0.2	0	-	-	-	-	-
York	Y.	8.2	0.9	0.7	0.7	14	96	2	2		100
Grimsby	Gri.1	(0.8)	0.8	(0.3)	0.3	0	99	0	0	1	100
	Gri.2	(3.5)	0.6	(1.5)	1.3	0	-	-	-	-	-

Figures in brackets are based on estimates.

Movements refer to movements of workers only. The movements of non-workers are parallel to but slightly in excess of those of workers.

4.3 Movements and the indices of the effectiveness of attack

The relationship between movements and the indices of effectiveness and weight of attack is best obtained by adding the percentages evacuating and trekking (ignoring the movements in the town which are less likely to be associated with loss of time from work). The results are given in graphical form in Fig. 4 which relates movements to casualties, and Fig. 5 which relates movements to the percentage of houses destroyed (A and B damage). These graphs show fairly good linear relationships as do those relating movements to the other indices of effectiveness of attack, effective density of bombing and percentage of buildings destroyed. The two latter figures have not been reproduced here as they give similar approximately linear relationships.

It can be seen from Fig. 5 that the percentage of population moving is three times the percentage of houses demolished. For H.E. damage only, the number of permanently uninhabitable houses is three times the number of those destroyed. This factor is usually reduced when an appreciable proportion of the damage has been caused by fire, as with most of the attacks considered here. Thus at Clydebank which suffered a particularly heavy attack and lost some 33% of its houses, the overlapping due to the intensity of attack and the high proportion of damage due to fire (59%) reduced the proportion of permanently uninhabitable houses. Moreover, lack of other accommodation may force people to live in damaged houses when they otherwise would not do so. In Clydebank 24% of the houses were, in fact, regarded as habitable (section 4.5).

4.4 Movements and house damage

An analysis of movements in relation to house damage shows, as one would expect, that the extent of the movements is directly related to the degree of house damage. (Table 11). The information relates to workers in Norwich and Exeter and McKeown states that it is characteristic of the other towns also.

TABLE 11

Movements of worker related to house damage* (for period 20 nights after raid)

NORWICH

Category of house damage	Percentage of time spent in:-				
	Evacuation	Trekking	Movement in the town	Living and sleeping at home	Totals
A, B and C_b	15	7	62	16	100
C_a	5	20	27	48	100
D	5	13	16	66	100
Undamaged	1	5	4	90	100
Totals	4	8	13	75	100

EXETER

Category of house damage	Percentage of time spent in:-				
	Evacuation	Trekking	Movement in the town	Living and sleeping at home	Totals
A, B and C_b	45	1	47	7	100
C_a	14	23	15	48	100
D	13	6	4	77	100
Undamaged	6	1	3	90	100
Totals	13	4	9	74	100

* Usual categories of house damage:-
A: Demolished
B: So severely damaged as to require demolition
C: Uninhabitable but reparable (C_a = during the war, C_b = after the war)
D: Habitable but requiring repair

POPULATION MOVEMENTS AND EFFECTIVENESS OF ATTACK.

FOR MEANING OF SYMBOLS SEE TABLE. 8.

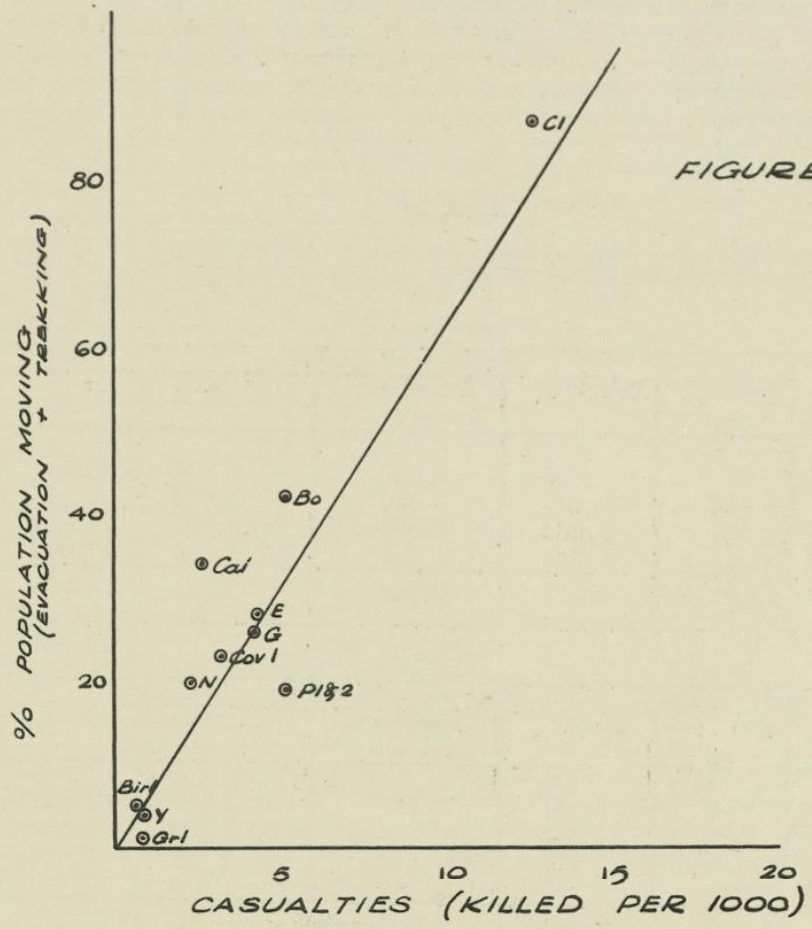


FIGURE. 4.

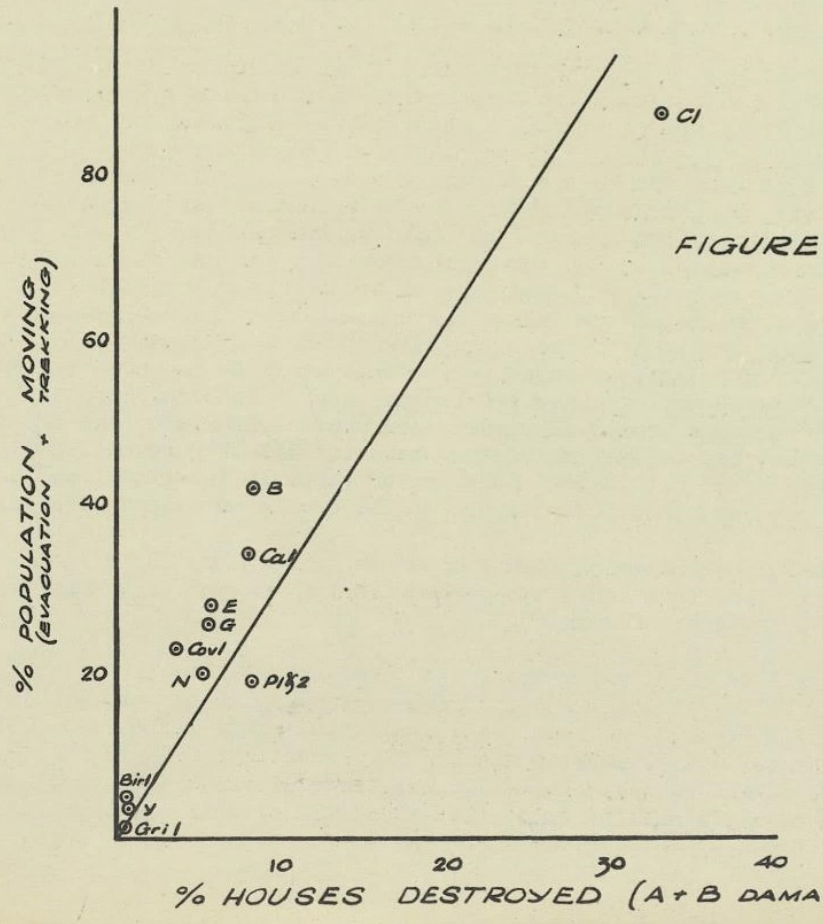


FIGURE. 5.

The Table covers a period of 20 nights after a raid and shows the percentage of the total time spent by workers in their own houses, in others in the town, in evacuation or in trekking. On the assumption that people spent the whole of their 20 nights in the same kind of movement it is possible to convert the percentages of workers engaging in the various forms of movement into numbers of workers and thus to see the significance of the percentages. These numbers are given in Table 12.

TABLE 12

Movements of workers related to house damage
(for period of 20 nights after raid)

NORWICH

Category of house damage	Numbers of workers				
	Evacuating	Trekking	Elsewhere in town	At home	Total
A + B + C_b	490	230	2,040	530	3,290
C_a	60	220	300	530	1,110
D	800	2,080	2,560	10,570	16,010
Undamaged	240	1,170	940	21,150	23,500
Totals	1,590	3,700	5,840	32,780	43,910

EXETER

Category of house damage	Numbers of workers				
	Evacuating	Trekking	Elsewhere in town	At home	Total
A + B + C_b	1,150	30	1,200	180	2,560
C_a	180	290	190	620	1,280
D	1,340	620	410	7,930	10,300
Undamaged	620	100	310	9,270	10,300
Totals	3,290	1,040	2,110	18,000	24,440

(In Norwich 43% of the people were workers and in Exeter 40%. 5.1% of houses were destroyed in Norwich and 4.8% in Exeter.)

In studying the two parts of Table 12 it should be remembered that in Exeter the transition from urban conditions to open country is comparatively abrupt whereas in Norwich it is gradual and extends over a considerable area. Thus in Norwich people might travel two miles or more from the centre of damage and still find themselves in a residential neighbourhood within the city boundaries, whereas at the same distance from Exeter they would be in open country with very little accommodation and in any case since they had passed the city boundary they would be regarded as evacuated. Thus the numbers evacuating from Exeter are relatively and actually larger than those from Norwich, but in both cases the bulk of those evacuating and trekking come from D damaged houses. The same tendency is shown in the figures of those moving elsewhere in the town. In Norwich nearly half of these came from D damaged houses whereas in Exeter the fraction was 1/5, that is, in Exeter, if they moved at all they moved right out of the city. In both cases about 75% of those in the city lived and slept at home and this included 90% of the people in undamaged houses.

From further material from the survey on Norwich, Table 13 has been compiled. This shows the percentages of non-workers moving in parallel with those of workers.

It will be seen, taking the first three weeks as equal to the 20 nights of Tables 11 and 12, that on the average 7% of workers evacuated (Table 13) whereas 4% workers evacuated according to Table 11. This difference is due to Table 13 giving the percentage of those who evacuated at all whereas Table 11 gives the equivalent percentage of workers evacuated all the time, i.e. the total of what may be called

worker/evacuation days is the same in both cases. For the other categories of movement the differences are much less and may be ignored.

TABLE 13

Norwich - Percentage of workers and non-workers evacuating, trekking, moving elsewhere in town and staying at home averaged over each week for 19 weeks after first raid

Weeks after 1st raid	Percentage of workers				Percentage of non-workers			
	Evacuating	Trekking	Elsewhere in town	At Home	Evacuating	Trekking	Elsewhere in town	At Home
*0	7	9	11	73	15	5	10	70
*1	8	7	11	74	17	4	9	70
2	6	6	10	78	16	3	8	73
3	5	5	10	80	15	2	8	75
4	5	4	10	81	15	2	7	76
5	4	3	9	84	14	2	7	77
6	4	3	9	84	13	2	7	78
7	3	2	9	86	12	2	7	79
*8	3	2	9	86	13	2	7	78
9	3	2	10	85	13	2	8	77
10	3	2	10	85	12	2	8	78
11	3	2	9	86	12	2	8	78
12	3	2	10	85	12	2	8	78
*13	3	2	9	86	12	2	8	78
14	4	3	10	83	14	2	8	76
15	4	2	10	84	14	2	8	76
16	4	2	10	84	14	2	8	76
17	4	2	10	84	14	2	8	76
18	4	2	10	84	13	2	8	77

* Weeks in which an air raid occurred. That immediately preceding week 0 was the heaviest (96 m. tons); the others were very slight (1½ m. tons or less).

In applying these results to other attacks and other cities it should be remembered that the initial attack on Norwich was not particularly heavy (effective density: 13.3 m. tons/square mile) and that a high proportion of the workers were women.

Table 16 gives comparable figures for the movements of workers for 8 weeks after the raid on Clydebank. Factors which may affect the results in this case are that the attack was abnormally heavy for one on a British town and that Clydebank is adjacent to and continuous with Glasgow.

Using all the available data on movements of population following an air raid on a British city or town, curves have been constructed representing the population movements likely to follow attacks in which up to 35% of all houses are destroyed. These curves, which are given in Fig. 6, necessarily ignore those differences between individual towns which have been discussed above and, therefore, when using the curves allowance should be made for this. Differences due to the basic data being calculated on time spent in the movements rather than on people moving is ignored particularly as for the greater degrees of house damage the results are likely to be the same; for instance, people evacuating are likely to stay away for weeks and not return within a few days as many do when there is only light damage.

4.5 Migration from Clydebank after the raids

Clydebank is the most interesting of the towns covered by the survey from the point of view of population movements. There were two heavy attacks on the burgh on consecutive nights, and these for practical purposes can be taken as Clydebank's only raids, and although

a few bombs fell on the burgh on May 5/6 and 6/7 when heavy attacks were directed against Greenock these had little effect.

The surveys revealed an incomparably greater degree of overcrowding in Clydebank and Greenock than that existing in the English survey towns. This merely confirmed, of course, the results of the national survey of overcrowding of 1936 but it is clear that both before the war and at the time of the raids Clydebank was grossly overcrowded.

The total number of houses and apartments was 11,945 and it had been estimated that an additional 2,550 apartments of 3 or more rooms were needed in 1941 to alleviate the conditions. It is evident therefore that at the time of the March 1941 raids the burgh had no housing reserve, and any loss of houses was certain to create a difficult situation.

Table 14 shows the houses demolished and damaged in the raids.

TABLE 14

Clydebank - Houses demolished and damaged

Class of Damage	A & B (Demolished)	C	D	Undamaged	Total
No. of houses	3991	592	7355	7	11945
%	33	5	62	-	100

(Figures provided by Clydebank Burgh).

It will be seen that 33% of houses were demolished, and a further 5% suffered major damage. Information provided by the Local Authority indicated that the percentage unfit for use however was, on the standards generally adopted, 76% of all houses. This implies that roughly 31,800 persons out of a population of 41,900 were homeless.

Work on repair was carried out during the two years after the raids, and Table 15 below gives the percentage of all houses available for habitation at the end of successive months. It will be seen that almost all D houses were ready for use after 7 months, by which time 61% of all dwellings could be lived in. New building was insignificant, and at the time of the survey the figure had only increased to 64%.

TABLE 15

Clydebank - Percentage of houses habitable after the raids

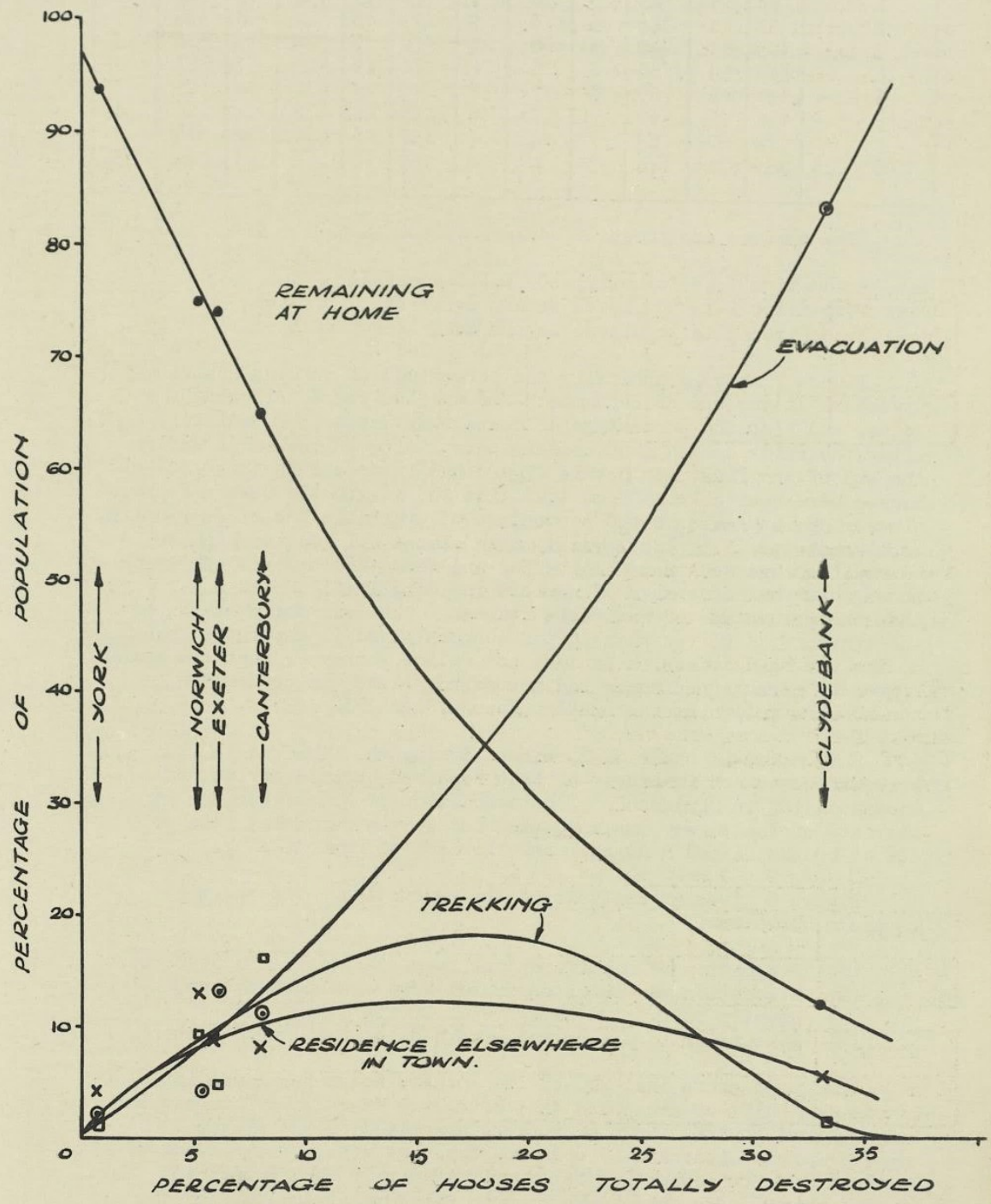
Month	Immediately after raids	1	2	3	4	5	6	7	8	9	10	11	12
% of habitable houses	24	24	24	34	44	49	56	61	61	61	61	61	61

Month	13	14	15	16	17	18	19	20	21	22	23	24
% of habitable houses	62	62	62	62	63	63	63	64	64	64	64	64

Table 16 gives the movements of Clydebank workers for 8 weeks after the raids. On the day after the first raid 38% of Clydebank workers evacuated, and after the second raid 86% left the town. A proportion of the remainder trekked at night, and since movements of non-workers usually exceed those of workers it is not surprising that a census taken 10 days after the raids found that only 2,000 persons spent the night in the burgh.

FIGURE . 6.

ANALYSIS OF POPULATION MOVEMENTS RELATED TO HOUSE DAMAGE.



DATA.

- • REMAINING AT HOME.
- ⊙ EVACUATION.
- ▫ TREKKING.
- × RESIDENCE ELSEWHERE IN TOWN.

TABLE 16

Clydebank - Movements of workers after raids

Weeks after raid	Living at home		New residence in town		Trekking		Evacuation* 1		Evacuation 2		Evacuation 3	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	79	9	45	5	6	1	171	19	559	63	26	3
2	93	11	46	5	6	1	172	19	541	61	28	3
3	109	12	49	6	8	1	168	19	524	59	28	3
4	115	13	58	7	8	1	170	19	508	57	27	3
5	137	16	65	7	7	1	172	19	480	54	25	3
6	144	16	65	7	7	1	169	19	476	54	25	3
7	178	20	63	7	4	-	158	18	459	52	24	3
8	181	21	64	7	4	-	159	18	454	51	24	3

(The numbers are those of workers in the sample. Total 886).

* Evacuation 1 is to contiguous built-up areas.
Evacuation 2 is to places within daily reach of town.
Evacuation 3 is to places beyond daily reach of town.

Figure 7 shows graphically the percentage of workers residing in Clydebank at the end of each month for the two years following the raids, and also the percentage of houses habitable. Immediately after the raids only 13% of workers were living in the burgh and by the end of the first month this figure had increased to 18%; 24% of houses were habitable. From that time the return of workers followed closely the increase in the percentage of available houses as repairs were completed. By the seventh month almost all houses which could be repaired had been made habitable, and from then onwards the graph shows that the percentage of workers residing in Clydebank was greater than the percentage of habitable houses. This was the position at the time of the survey when 74% of workers lived in the burgh in 64% of the pre-raid houses. It does not follow, however, that the mean number of persons per house had increased, since the percentage of non-workers returning was smaller than of workers.

This makes it clear that, except during the first month, the evacuation was not in excess of that required because of lack of accommodation in Clydebank. The evacuation of 26% of workers at the date of the survey was accounted for by the permanent loss of 33% of houses (A and B damage) and the lack of new building.

Figure 8 gives an analysis of the evacuation. It shows a separate curve for:

(1) Evacuation to contiguous built-up areas (chiefly Glasgow).
(2) Evacuation to places separated from Clydebank by open country but within daily reach of the burgh.
(3) Evacuation to places not within daily reach of Clydebank.

The graph shows that 20% of the workers found new homes in contiguous built-up areas and that after two years this figure was only reduced to 12%. 60% of workers evacuated to the places separated from Clydebank by open country, but within daily reach of the burgh. The proportion fell considerably in each subsequent month, and 12% of workers were in this category at the time of the survey in February, 1943. 3% of workers evacuated to areas not within daily reach of Clydebank, and the majority had not returned.

These results are likely to be generally true of evacuation from a heavily-damaged area within a much larger built-up area in which the overall damage is not serious such as Clydebank within the Glasgow area and Bootle within the Liverpool area. A proportion of the evacuees are absorbed in the rest of the built-up area

FIGURE. 7.

PERCENTAGE OF WORKERS LIVING IN CLYDEBANK COMPARED WITH PERCENTAGE OF HABITABLE HOUSES

(FOR TWO YEARS FOLLOWING RAID)

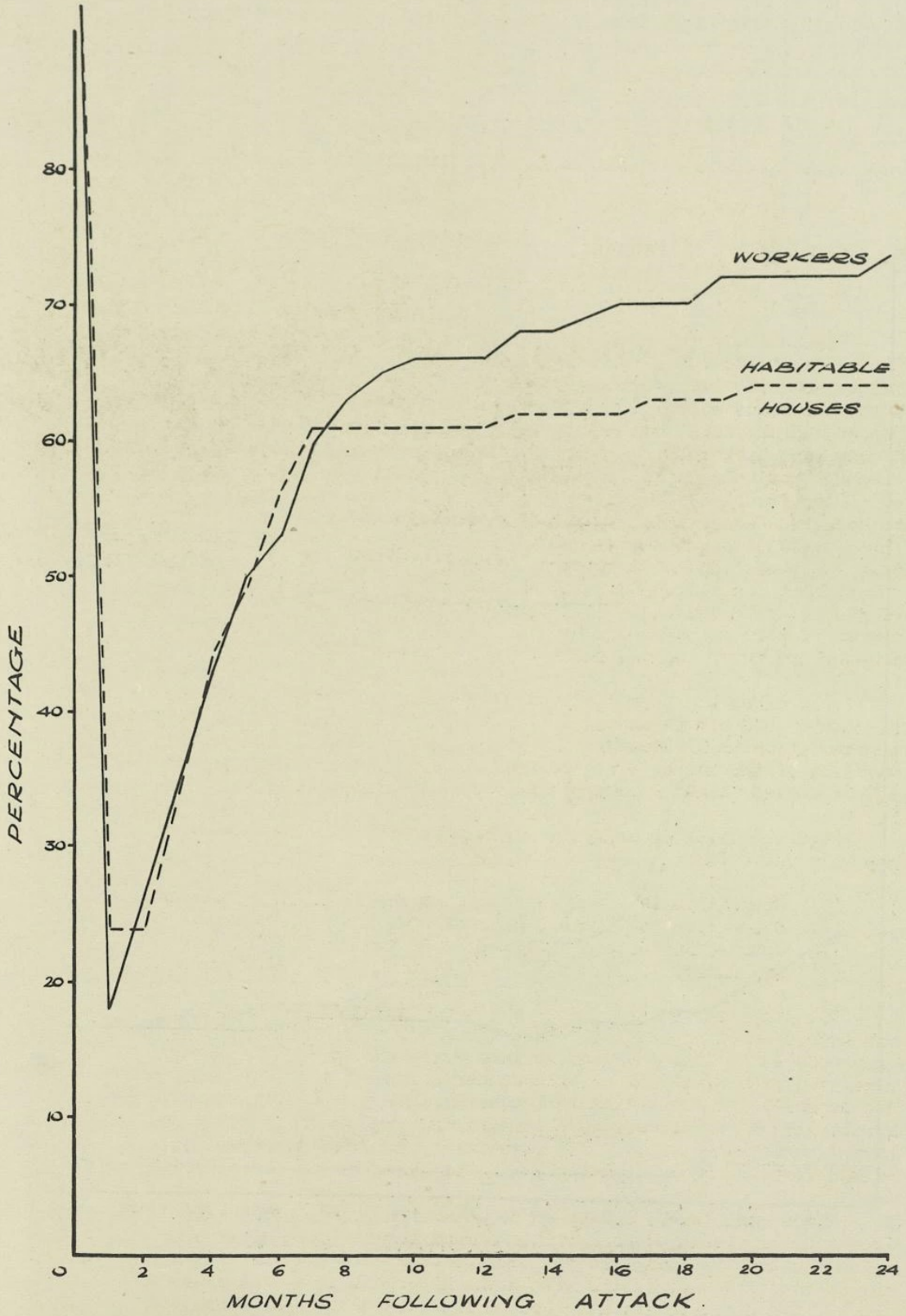
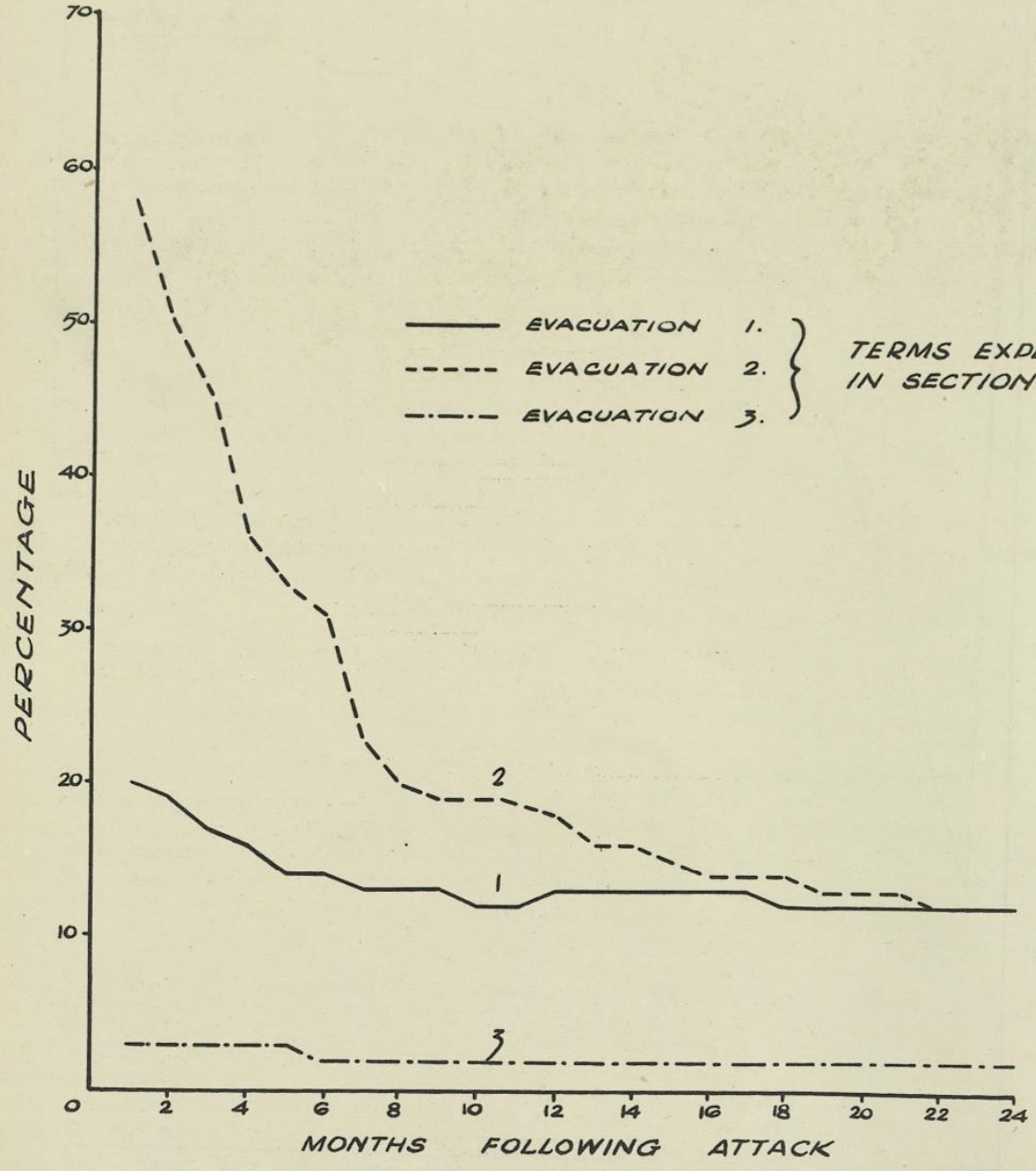


FIGURE. 8.

PERCENTAGE OF WORKERS EVACUATED FROM CLYDEBANK.

(FOR TWO YEARS FOLLOWING RAID)



(Evacuation 1), but a larger proportion evacuate to neighbouring towns (Evacuation 2). These latter evacuees, however, tend to return, at least in the absence of further raids, much more quickly than the former; in Clydebank the factor limiting this return was the number of houses actually available.

Table 17 gives the distribution at the time of the survey (nearly two years after the raids) of the workers in each industry living in Clydebank before the raids.

TABLE 17

Clydebank - Distribution in February, 1943, of workers living in Clydebank on March 13th, 1941

Industry	No. in sample	Percentage				Total %
		In Clyde-bank	Near Clyde-bank	Else-where	Called up, killed and died	
Shipbuilding and repair						
John Brown Ltd.	238	77	17	2	4	100
Other firms	79	67	22	2	9	100
War industry						
Singer's Manufg. Co. Ltd.	179	71	23	2	4	100
Other firms	153	64	26	4	6	100
Transport	19	63	26	11	0	100
Distributive trades	129	68	24	2	6	100
Miscellaneous	100	60	31	7	2	100
All workers	897	69	23	3	5	100

It will be seen that 69% of the workers who were living in Clydebank before the raids were residing there at the time of the survey. For John Brown Ltd. the percentage was 77, and for other firms engaged on shipbuilding and repair 67. The percentages in war industry are roughly similar (71% Singers; 64% all other firms).

These figures will agree with those from Fig. 8 if allowance is made for the 5% called up, killed etc. in Table 17 who are omitted from Fig. 8.

4.6 Conclusions

It has been shown that, in general, the percentage of people moving (evacuating and trekking) is directly proportional to the weight of attack and is approximately three times the percentage of houses destroyed (A + B damage) and three times the number of casualties per thousand of the population (or thirty times the percentage of population killed).

Fairly comprehensive information is given about the movements of people in towns suffering about 5% houses destroyed but little is available for heavier attacks save for that on Clydebank in which 33% of the houses were destroyed. Using this information a series of curves has been constructed giving the probable movements for attacks between these limits. The curve shows that the maximum percentage of people likely to trek from any town will probably not exceed 20% (with 15% to 20% of houses destroyed) since for higher rates of damage the percentage evacuating completely increases rapidly.

Movements are related to the degree of house damage and are analysed in detail for Norwich and Exeter. The two cases agree well but the percentage of houses destroyed was in both cases between 5% and 6%. It is surprising to find how many people continue to live in houses officially condemned as uninhabitable while at the same time one-third of those in slightly damaged houses leave them to evacuate, trek or move elsewhere in town. At Clydebank, however, evacuation was little in excess of that necessary because of lack of accommodation which, compared with Exeter where 3/5 of the total numbers evacuating came from undamaged or slightly damaged houses, seems to show that for a heavy attack when those able and willing to evacuate have done so, the evacuation of the remainder is, at least in part, related to the living accommodation remaining in the town, subject, of course, as at Clydebank, to there being no panic or large scale loss of morale among the people.

5. POST-RAID ABSENTEEISM

5.1 Introduction

Air raids reduce the total volume of production available for war purposes mainly in two ways

(1) by direct damage to factories and
(2) indirectly, by damage to non-industrial property.

Damage to factories results in loss of production by interruption of work and disorganisation of the production processes. It also causes a drain on, for example, materials and machinery from undamaged factories, to make good the damage to buildings, plant, machinery and stocks.

Damage to non-industrial property similarly causes a drain on available productive resources. In either case the actual amount of the drain depends on how much damage is made good, and this will in turn depend on the amount of available equipment and the priority ratings for its use.

In addition to the effects of damage and possible casualties, the production from a given number of workmen is reduced by the direct effects of air raids on the workers themselves, causing absenteeism and loss of productive efficiency.

While this chapter is chiefly concerned with absenteeism, the effects of the two types of damage discussed above, must be considered in order to put the labour problem into its proper perspective and the further question of loss of efficiency of labour is studied in Chapter 6.

The term "absenteeism" has recently acquired a slightly censorious flavour, implying deliberate staying away from work for inadequate reasons. While a few of the absences "for personal reasons" in this study may come under this heading, the term is used here to mean nothing more than absence from work.

5.2 Assessment of absenteeism

In each town a measure of absenteeism was obtained in the house-to-house survey by asking workers how long they were absent after the raids, and if absent, whether because work was not available or because of personal reasons.

Workers were classified on the interview form under the heading of "work not available" if this was the initial cause of absence, even if they remained absent after work again became available. In Norwich a small part of the absenteeism classified as "work not available" is to be attributed to shortage of labour, for some of the factories were unable to operate because only a small percentage of their total labour turned up for work. Occasionally workers may have given incorrect answers and said that they were absent because work was not available when in fact they were absent for personal reasons, or vice versa, but such checks as can be made indicate that this did not often occur.

Decision as to what absenteeism could properly be attributed to the raids rested with the field-workers. Absenteeism for reasons not connected with the raids, as for sickness or holidays, was excluded throughout and workers out of work or absent from the towns at the time of the raids (from 1% to 3% of all workers) have also been excluded.

Loss of time is in itself a complex phenomenon, and the mere uncritical addition of all days lost, in so far as they are known, by all workers may give misleading results, which moreover vary to a considerable extent with the period that elapses between the raids and the survey. Some workers are killed or permanently disabled and these represent a permanent loss to the labour force, as do those who cease work as the result of nervous reaction. For the remainder absence from work extends over widely varying periods. Some workers change their type of work, and some move to other areas, but it cannot be assumed that all such changes are disadvantageous to the war effort.

In the present analysis loss of time has been calculated for periods of 3 weeks[*], 16 weeks and 2 years after the raids. The losses of time over the longer periods must be treated with caution because, in general, it is to be suspected that workers with very long periods of absenteeism (other than those due to injury) would probably be of less than average value if they were working. Thus in Bootle 2.2% of all workers were still absent 16 weeks after the raids. These, however, were all women, mainly juvenile or elderly; men in Bootle had all returned to work within 12 weeks after the raids.

5.3 Evaluation of loss of time

The basic data obtained from the surveys are shown in Table 18 and summarised in Table 19 which gives in addition the density of attack, material damage and loss of working time for all causes in the various towns studied. For the 3-week period the values are as in Table 18 but for the 16-week and full periods time lost because workers have "left area" is excluded save for that lost in the first three weeks. Thus the figures given in the 9th and 10th columns of Table 19 are obtained by adding the days lost because work was not available, for personal reasons or because the worker was killed or injured, to the days lost because the worker has "left area" given in column 7 of Table 18.

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[*] The actual period taken for most towns was 17 working days, this being the longest period covered by all surveys. This is practically equivalent to 3 weeks (18 working days).

TABLE 18

Estimates of loss of time obtained from surveys
(Days lost per worker)

Town	Ref.	No. of workers in sample ¤	3-week Period					16-week Period			Full Period			
			Work not available ¤¤	Personal Reasons	Killed and Injured	Left area	Total	Work not available ¤¤	Personal Reasons	Killed and Injured	Work not available ¤¤	Personal Reasons	Killed and Injured	No. of days in full period
Clydebank	Cl	864	1.43	5.03	0.76	0.35	7.57	3.19	8.94	2.98	10.06	16.41	10.74	576
Bootle	Bo	681	1.98	2.18	0.23	0.42	4.81	3.92	3.68	1.23	6.52	5.65	4.69	432
Canterbury	Ca 1	293	0.91	1.13	0.25	-	2.29	-	-	-	-	-	-	-
	Ca 2	431	0.31	0.75	0.04	-	1.10	-	-	-	-	-	-	-
Plymouth	P 1	797	0.49	0.28	0.09	0.23	1.09	1.43	0.74	0.41	2.40	2.24	2.52	672
	P 2	715	0.71	0.70	0.09	0.21	1.71	2.16	1.64	0.54	3.24	2.93	3.04	640
	P 3	742	-	0.06	-	-	0.06	-	-		-	-		-
Exeter	E 2	463	2.07	0.62	0.17	0.37	3.23	3.68	1.29	0.51	-	-	-	-
Norwich	N 1	542	1.07	0.93	0.26	-	2.26							
	N 2	561	0.16	0.05	-	-	0.21	1.44	1.96	0.21	-	-	-	-
	N 3	570	0.24	0.09	-	-	0.33							
Greenock	G	824	1.93	1.91	0.25	0.23	4.32	2.62	3.78	0.88	2.87	6.27	2.93	528
Coventry	Cov 1	1014	2.54	1.14	0.19	0.50	4.37	3.52	2.48	0.57	4.22	4.09	1.30	700
	Cov 2	919	0.76	0.42	0.19	0.17	1.54	1.26	0.71	0.80	2.19	1.32	4.00	586
Birmingham	Bir 1	2031	0.63	0.72	0.09	0.06	1.50	1.13	1.40	0.36	3.06	3.24	0.89	738
	Bir 2	1954	0.07	0.20	0.02	-	0.29	0.14	0.31	0.10	0.46	0.31	0.42	720
	Bir 3	1963	0.10	0.27	0.06	-	0.43	0.19	0.41	0.23	0.46	0.55	0.78	624
York	Y	507	0.13	0.39	0.08	-	0.60	-	-	-	-	-	-	-
Grimsby	Gri 1	554	0.06	0.16	0.13	.03	0.38	-	-	-	-	-	-	-
	Gri 2	540	0.17	0.35	0.03	-	0.55	-	-	-	-	-	-	-

¤ Excluding untraced households, unemployed, absenteeism unconnected with the raids and workers about whom information was incomplete.

¤¤ Including those for whom work was originally not available but who subsequently lost time for personal reasons.

The reason for excluding apparent loss of time for those marked "Left area" after 3 weeks is that, although these workers left the town, it is to be expected that the more efficient of them would rapidly find work elsewhere. In so far as the destruction of factories in heavy raids leads to a lessened need for workers in a town, a certain amount of migration may actually benefit the war effort by facilitating the transfer of workers to other factories.

For Exeter the actual survey data extended over 12 weeks, and extrapolation was used to estimate the loss over the 16-week period.

Apart from the loss of time included in Table 18, loss of time by untraced workers and by those of whom there was insufficient information must also be taken into account.

The actual percentages falling in these two categories in the present surveys are given in Table 20.

Since the number of workers in each sample bears a fixed relationship to the number of families in the sample it is legitimate here to add the percentage of untraced families to the percentage of workers about whom there is insufficient information in order to find the total percentage of workers in both classes together.

It must not be assumed that all these workers were necessarily lost to the area, still less that they ceased to work. Circumstances vary in the different surveys. In the case of Clydebank, for instance, the field-workers report of the "untraced" that "in almost every case enough was known to indicate that they were representative of the whole sample". The first survey on Norwich (the first of all the surveys), on the other hand, gave grounds for believing that most of the untraced workers were from damaged firms and left the town, but most of these probably obtained work elsewhere.

On the whole, therefore, it would appear best not to make any special allowance for this class of worker, but to assume that the effective loss of time is the same as for workers of whom information was available.

5.4 Loss of time and the indices of effectiveness of attack

The values of the loss of time given in Table 19 can be related to the various indices of weight and effectiveness of attack also given there. The relationships for the 17-day period are shown in graphical form in Figs. 9 to 12.

Loss of time from all causes is related in

Fig. 9 to percentage of all buildings destroyed;
Fig. 10 to percentage of houses destroyed (A and B damage);
Fig. 11 to weight of attack (effective density); and
Fig. 12 to casualties (killed per 1,000 population).

In general, these graphs all show reasonably consistent linear relationships and reasonable conformity among themselves. The first raid on Coventry, which was also the first of the raids studied here, appears to have caused the greatest loss of time for its weight however measured. The first series of raids on Birmingham which followed 5 days later also caused excessive loss of time. It is probable that these raids which initiated the series of sharp attacks on provincial towns and cities, caused excessive dislocation mainly because of lack of experience of the organisation necessary to meet them, and it is of interest to note that the raids on

TABLE 20

Workers excluded from the analysis because of insufficiency of information

	Clydebank	Bootle	Canterbury 1	Canterbury 2	Plymouth	Exeter	Norwich 1	Norwich 2	Greenock	Coventry	Birmingham	York	Grimsby
Untraced (% of households)	6	3	0	0	4	0	2	2	2	2	3	0	0
Insufficient information (% of workers)	1	4	0	0	4	4	4	1	1	4	2	0	1
Total %	7	7	0	0	8	4	6	3	3	6	5	0	1

Greenock*, some six months later, caused exceptional loss of time for personal reasons and loss of morale which has been attributed to inefficient local administration.

The two-night Clydebank raid was exceptional, both in weight of attack, and in the amount of damage done and numbers of casualties. Relative to the weight of attack, however measured, Clydebank shows proportionately less total loss of time than the other towns, but the raid was also exceptional in that loss of time was predominantly for personal reasons; the shipbuilding yards were little damaged, and Singer's, the other large industrial concern in the town, was able to employ most of its workers immediately on clearance and repair.

The raids included in the study differ widely in regard to the nature of the attack. In Bootle the raiding was spread over a week; in both Clydebank and Greenock there were concentrated attacks on two consecutive nights; the raid covered by the second survey of Canterbury took place in part in daylight on a Saturday afternoon; the first group of Norwich raids occurred on two nights with a raid-free night between them; the second Exeter group, and the York raid were single night raids; the Bootle, Clydebank and Greenock raids occurred in 1941, the others in 1942 and 1943. Bootle, Greenock and Clydebank are, moreover, towns of a very different nature from the Baedeker towns.

The surveys, however, show no consistent differences associated with these differences in type of raid, time and town; nor is there any indication of a threshold value. The low loss of time in the York raid relative to density of attack is, for instance, counterbalanced by the high loss relative to amount of damage. It may therefore be concluded that on the scale experienced, attacks of a given weight will produce much the same effect in different towns, whether they are concentrated into a single night or spread over several nights, provided that similar amounts of damage are effected in both cases. Moreover, from the evidence of the two Canterbury raids, there does not appear to be any striking difference between daylight and night raids, though no final conclusion can be drawn from a single raid of this kind, complicated as it was by a subsequent night attack and particularly as it is known, for instance, that casualties tend to be higher in day than in night raids.

5.5 Expression of the loss of time relationships in numerical form

Since the relationships shown in Figs. 9 - 12 cannot be linear over the whole range, curves have been fitted in two cases as explained in Appendix VI. It will be seen that over most of the range covered there is little difference between the values from the curves and the straight lines fitted to the same data. The use of proportionate values derived from the straight lines should, therefore, be adequate, having regard to the other uncertainties of the data. The use of proportionate values also has the advantage that it enables the results to be stated more simply and provides compensation for the greater proportionate loss of time in periods subsequent to the first 3 weeks after the heavier raids.

The following numerical values (Table 21) were obtained for the relationships between loss of time and the various indices of weight of attack.

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* McKeown suggests that the discrepancy shown by Greenock may be due to an underestimation of the weight of attack on the town but as Greenock appears abnormal in respect of the other three indices of effectiveness of attack also, it may be fairly considered as showing exceptionally high loss of time from work.

LOSS OF TIME FROM ALL CAUSES

(FOR 3 WEEKS AFTER ATTACK)

FOR MEANING OF SYMBOLS SEE TABLE 8
THE DOTTED LINES INDICATE THE LIMITS OF ERROR OF THE ESTIMATE GIVEN BY THE CORRESPONDING FULL LINES.

FIGURE . 9.

LOSS OF TIME AND BUILDING DAMAGE.

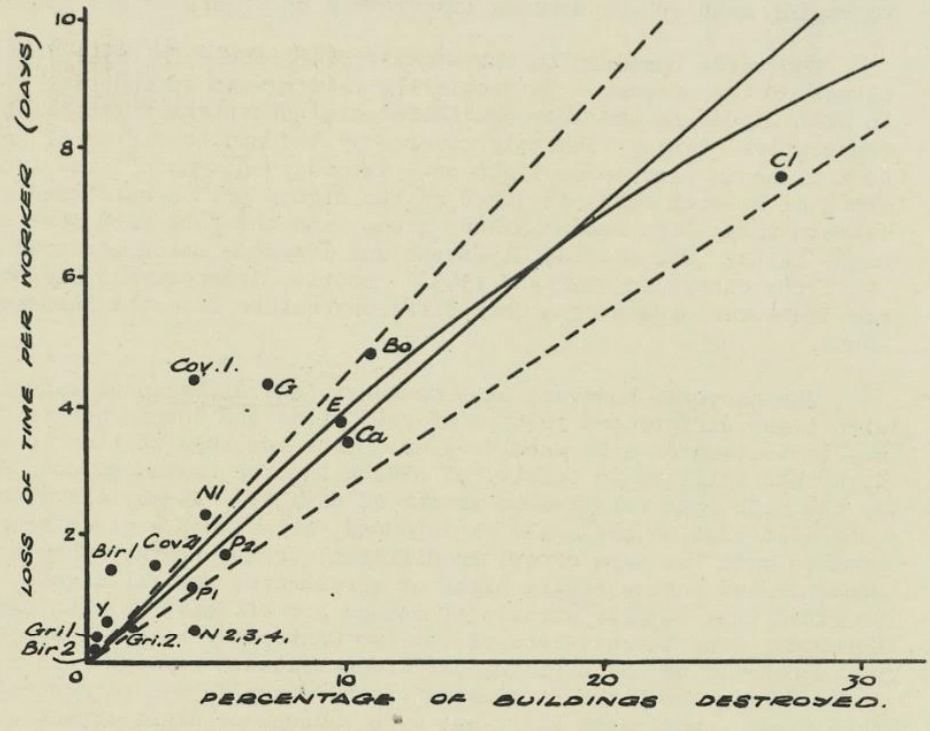
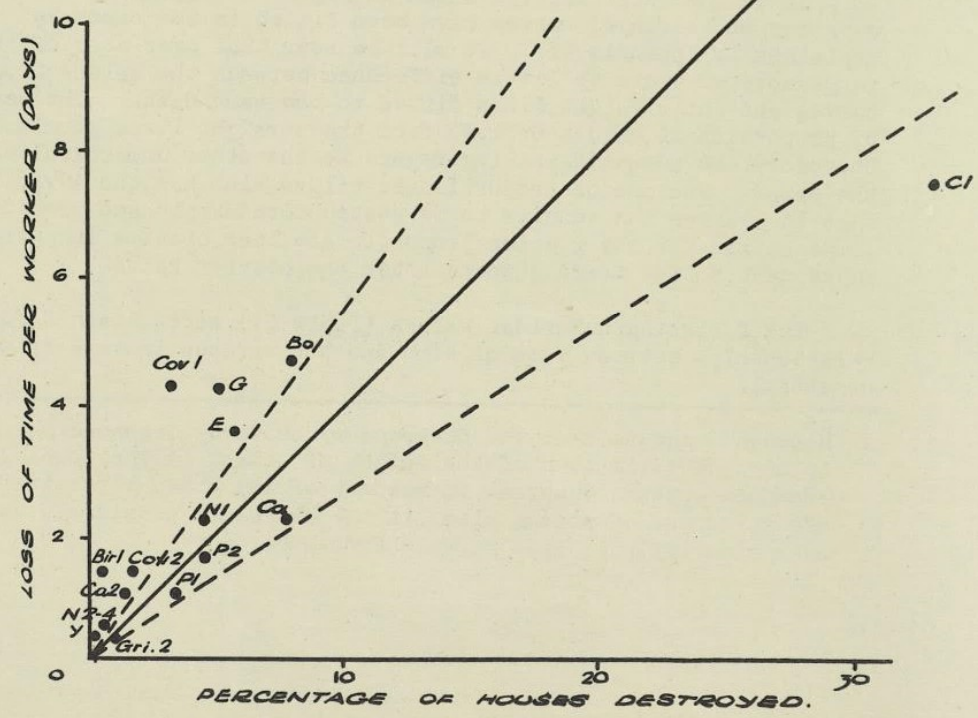


FIGURE . 10.

LOSS OF TIME AND HOUSING DAMAGE.



LOSS OF TIME FROM ALL CAUSES

(FOR 3 WEEKS AFTER ATTACK)

THE DOTTED LINES INDICATE THE LIMITS OF ERROR OF THE ESTIMATE GIVEN BY THE CORRESPONDING FULL LINES. FOR THE MEANING OF SYMBOLS SEE TABLE 8.

FIGURE. 11.

LOSS OF TIME AND DENSITY OF ATTACK.

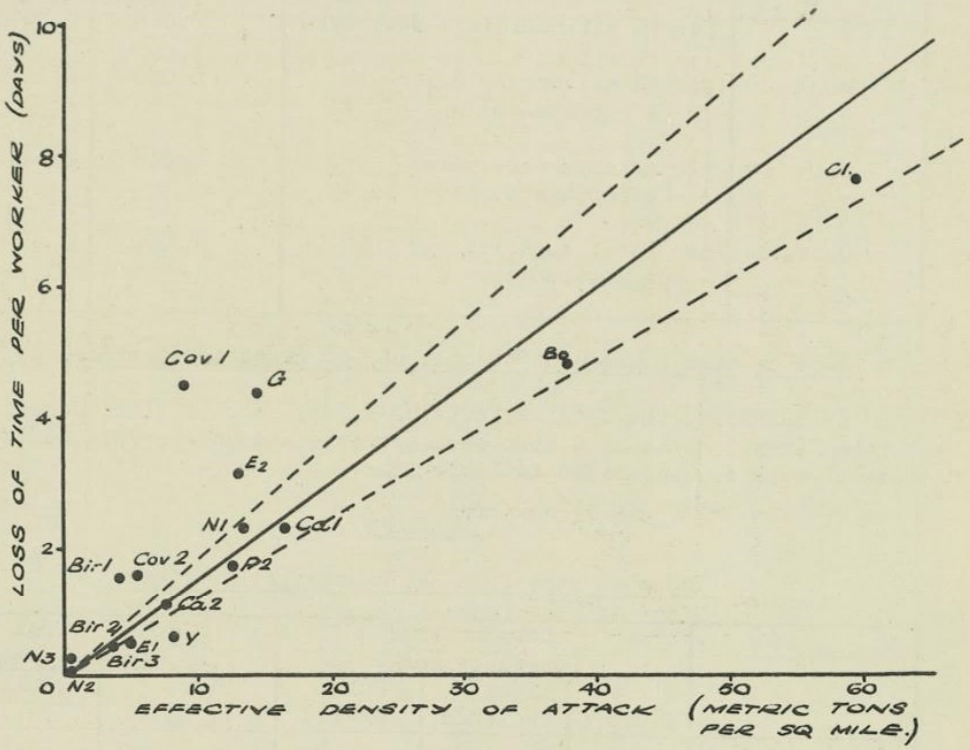
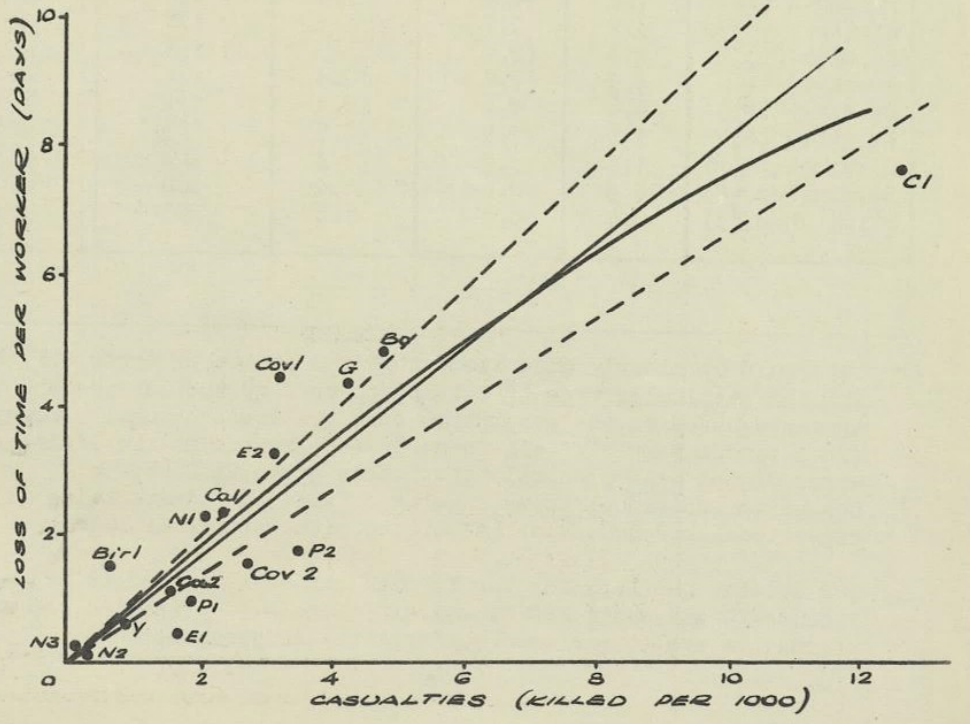


FIGURE. 12.

LOSS OF TIME AND CASUALTIES



The lines corresponding to the proportionate losses of time and to the limits of error of these proportionate losses are shown in the figures*, and described in Appendix VI.

TABLE 21

Loss of time - numerical relations with indices of attack
(first three weeks - 17 days only)

Loss of time per worker (days)	Index of attack	Standard error (days)	Limits of error (days)
0.37	per 1% all buildings destroyed	0.048	0.28-0.46
0.40	per 1% all houses destroyed (A + B damage)	0.080	0.26-0.54
0.15	per m.ton/square mile (effective density)	0.016	0.12-0.18
0.81	per fatal casualty per 1000 population	0.080	0.66-0.96

5.6 Loss of time subsequent to that of the first three weeks

In assessing the total effects of raids, loss of time subsequent to the first 3 weeks must also be taken into account. This additional loss of time is summarised in Table 22.

TABLE 22

Loss of time from all causes (all periods)

Town	Loss of time (days per worker)			% loss of that of first 3 weeks	
	First 3 weeks	First 16 weeks	Full Period	First 16 weeks	Full Period
Clydebank	7.6	15.5	37.6	204	495
Bootle	4.8	9.2	17.3	192	361
Plymouth (1)	1.1	2.8	7.4	255	673
Plymouth (2)	1.7	4.6	9.4	270	553
Exeter	3.2	5.7	-	178	-
+Norwich (1)	2.3	(3.1)	-	135	-
Greenock	4.3	7.5	12.3	174	286
Coventry (1)	4.4	7.1	10.1	162	230
Coventry (2)	1.5	2.9	7.9	193	526
Birmingham (1)	1.5	3.0	7.3	200	487
Birmingham (2)	0.3	0.6	1.2	200	400
Birmingham (3)	0.4	0.8	1.8	200	450

* It should be clearly understood that the limits of error only hold for the particular type of raiding covered by the surveys and that they are based on the assumption that the towns actually surveyed are a random sample of all towns. They represent the limits of error of the mean proportionate losses given in Table 21. Losses in individual towns may lie outside the limits owing to exceptional circumstances associated with particular raids.

+ For Norwich the loss for the 16-week period is placed in brackets because it was estimated from a different survey and the two sets of results are, therefore, not strictly comparable.

As pointed out above, the loss of time in the later periods is likely to have less effect on the war effort than that in the earlier periods, because it is largely confined to the less effective parts of the labour force. A rough allowance for this has been made by reducing the loss of time in the 4-16 week period by one-third and subsequent loss by two-thirds. Values for the "adjusted losses" expressed on this basis as percentages of the loss during the first 3 weeks are given below in Table 23.

TABLE 23

Adjusted loss of time from all causes (all periods)

Town	Adjusted loss of time (percentage of first 3 weeks)		
	3-week period	16-week period	2-year period
Clydebank	100	169	266
Bootle	100	161	217
Plymouth (1)	100	202	341
Plymouth (2)	100	212	306
Exeter	100	151	-
Norwich	100	(123)	-
Greenock	100	149	186
Coventry (1)	100	141	174
Coventry (2)	100	161	272
Birmingham (1)	100	167	253
Birmingham (2)	100	167	234
Birmingham (3)	100	167	250
Mean Value	100	164	250

This table indicates that, as a rough working rule, the loss over the 16 week period may be assessed at $1\frac{1}{2}$ times that in the first 3 weeks, while the total loss over a period of approximately 2 years may be taken as $2\frac{1}{2}$ times that in the first 3 weeks. The values given in Table 21 should therefore be multiplied by these factors to give the "adjusted" losses of time for the longer periods.

5.7 Loss of time in different industries

Tables 50 - 60 in Appendix IX give the loss of working time caused by the raids in different industries. The time lost is from all causes, and is shown for a period of 3 weeks (17 working days) after the raids. Various factors affect the time lost in a particular industry including

(1) The percentage of female workers employed. It is shown in Chapter 6 that women on the average lose more time from work than men.

(2) The degree of damage to the place of work.

(3) The percentage of workers living outside the town, or in the lightly-bombed areas within the town.

Of the eleven towns studied, in all but Grimsby, Bootle and York, least time was lost by transport workers and by persons in Government service. In York the transport workers cannot really be compared, since they include a large number of persons employed in the carriage works who might more properly have been classified under industry. The excellence of time-keeping by transport workers is probably related to the fact that the proportion of female workers (between 5% and 29%) is relatively small.

5.8 Conclusions

Loss of time for all causes (other than sickness etc. unconnected with the raids) is thus shown to be in general directly proportional to the weight of attack whether measured by effective density, percentage of buildings or of houses destroyed or by the number killed per thousand of population. Moreover there appear to be no consistent differences in absenteeism associated with differences in type, duration, or intensity of raid or of the type of town on which it was made. The overall figures for loss of time from work are summarised in Table 24 below.

TABLE 24

Loss of time from all causes per worker related to indices of effectiveness of attack for three periods following a raid

Loss of time per worker (days)			Index of effectiveness of attack
3 weeks	16 weeks	2 years	
0.37	0.56	0.93	per 1% buildings destroyed
0.40	0.60	1.00	per 1% houses destroyed
0.15	0.23	0.38	per m.ton/square mile effective density
0.81	1.22	2.03	per fatal casualty per 1000 population

6. ASSESSMENT OF POST-RAID MORALE FROM POST-RAID ABSENTEEISM

6.1 Introduction

An important factor influencing the effectiveness of raids but one very difficult to assess is the state of morale of the people exposed to risk. In this sense morale refers to the state of mind of the population as a whole, and states of mind are difficult to measure. In order to attempt its measurement, therefore, it was necessary to restrict its meaning on the grounds that, in war, deterioration of morale only becomes significant when it begins to affect essential work. In this conception the morale of non-workers is irrelevant except as it influences the behaviour of workers, and the willingness and ability of workers to continue to work effectively becomes the measure of morale. In considering the effect of raids on morale, therefore, a special study of the post-raid absenteeism for personal reasons and the reduced efficiency of those at work after a raid was made. For the first of these information was obtained from the social survey and for the second from the large Norwich shoe industry, and from the Singer Manufacturing Company in Clydebank.

6.2 Post-raid absenteeism for personal reasons

6.2.1 Loss of time for personal reasons and effectiveness of attack

In Chapter 5 it was stated that the causes given for absence from work after raids could conveniently be used to divide absentees into (1) those for whom work is not available and (2) those for whom work is available, but who remain away for personal reasons.

It is clear that a proportion of the workers in group (1) would have been absentees on personal grounds even if work had been available to them, so that an adjustment must be made if the loss of time by workers in group (2) is taken to measure the effect on labour. In this way an estimate can be made of the loss of work which would have resulted from a raid even had all employers been able to use their labour force. Table 25 gives the loss of time for personal reasons, with the four indices of the weight of attack (compare with Table 19). Time lost by workers killed or injured or who left the area after the raids is excluded.

There is a sharp discrepancy, however, between the figures given in the last column of Table 25 and those in column 5 of Table 18 (days lost per worker in the first 3 weeks for personal reasons). Table 18 represents data derived directly from the survey, while Table 25 gives those used in preparing Figures 13-16

TABLE 25

Density of attack, material damage and loss of working time for personal reasons

Town	Ref.	Effective density	Casualties (killed) per 1,000 population	Material damage			Loss of working time for personal reasons (days per worker in first 3 weeks
				% buildings destroyed	Houses demolished %	% of damage due to fire	
Clydebank	Cl	(60.2)	12.6	(27)	33	59	6.5
Bootle	Bo	(38.0)	5.2	(11)	8.1	24	2.8
Canterbury	Ca 1	16.5	2.6	(10)	8.0	38	1.3
	Ca 2	7.7	1.9		1.5		0.8
Plymouth	P 1	(9.3)	1.9	(4.1)	3.5	56	0.3
	P 2	(12.5)	3.4	(5.2)	4.7		0.8
	P 3	0	0.1	0	0.2	0	0.1
Exeter	E 1	5.0	1.5	9.8	5.8	60	0.2
	E 2	13.2	2.9				0.9
Norwich	N 1	13.3	2.2	4.6	4.8	25	
	N 2	0	0.1	4.1	0.3		0.1
	N 3	0.3	0				0.1
	N 4	2.3	0				
Greenock	G	(14.9)	4.2	(7)	5.2	51	3.0
Coventry	Cov 1	(9.1)	3.1	(4.0)	3.5	20	2.0
	Cov 2	(5.1)	2.6	(2.5)	1.9	9	0.5
Birmingham	Bir 1	4.2	0.6	(0.7)	0.6	0	0.8
	Bir 2	1.7	0.2	(0.1)	0.1	0	0.2
	Bir 3	3.2	0.4	(0.3)	0.2	0	0.3
York	Y	8.2	0.9	0.7	0.7	14	0.4
Grimsby	Gri 1	(0.8)	0.8	(0.3)	0.3	0	0.2
	Gri 2	(3.5)	0.6	(1.5)	1.3	0	0.4

(Figures in brackets are based on estimates)

and thereafter. There is nothing to explain this discrepancy and examination of the figures shows that there is neither a constant ratio nor a constant difference relating them. It must be assumed that the figures used by McKeown and Yates have been corrected in some way and that they consider that these figures (in Table 25) represent the truth better than those taken direct from the survey.

The relationships of the table are shown in graphical form in Figures 12-15.

Loss of time for personal reasons is related in Fig. 13 to the percentage of all buildings destroyed, in Fig. 14 to the percentage of houses destroyed (A and B damage), in Fig. 15 to the weight of attack (effective density) and in Fig. 16 to the casualties (killed) per 1000 population.

The graphs show reasonably consistent linear relationships. For the towns studied, therefore, the loss of time for personal reasons was roughly proportional to the weight of attack, and on this evidence loss of morale cannot be said to have increased the effectiveness of these raids in general. The loss of time for personal reasons in Greenock shows more marked deviations from the average than those in Figures 9-12 in Chapter 5 where all causes of absence were included.*

6.2.2 Further analysis of causes of absence

In a later survey, made in Norwich by two psychiatric social workers, causes of absence which elsewhere have been separated only into "work not available" and "other causes" were considered in detail. It was found that they could be conveniently classified as follows:-

(1) Work not available.
(2) Work available but absent because of
  (a) nervous causes,
  (b) personal duties arising out of raids,
  (c) injury or
  (d) unclassified.

Absentees were not classified under (a) unless nervousness, worry, upset, etc., were specifically given as the reason for absence. There was considerable variety in the personal duties which included clearing up at home, finding new accommodation, looking after relatives and so on. The results of the Norwich survey which covers a six-month period after the raids are given in Table 26. It will be seen that of workers absent for personal reasons the majority give personal duties as their reason; over a six-month period, however, nervous causes are easily most important, accounting for almost 50% of the time lost from all causes.

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* McKeown here again suggests that part of the discrepancy may be due to an underestimation of the weight of attack on Greenock on the ground that in relation to casualties, the loss of time was but slightly above the average value. He makes no reference to either Coventry 1 or Birmingham 1. Comparison of the four curves (Figs. 13-16), however, shows that, in each, all three raids lie above the limit of error. It seems reasonably certain, therefore, that for these raids loss of time for personal reasons was abnormally high.

LOSS OF TIME FOR PERSONAL REASONS
(FOR 3 WEEKS AFTER ATTACK)

FOR MEANING OF SYMBOLS SEE TABLE . 8.

THE DOTTED LINES INDICATE THE LIMITS OF ERROR OF THE ESTIMATES GIVEN BY THE CORRESPONDING FULL LINES.

FIGURE . 13.

LOSS OF TIME AND BUILDING DAMAGE.

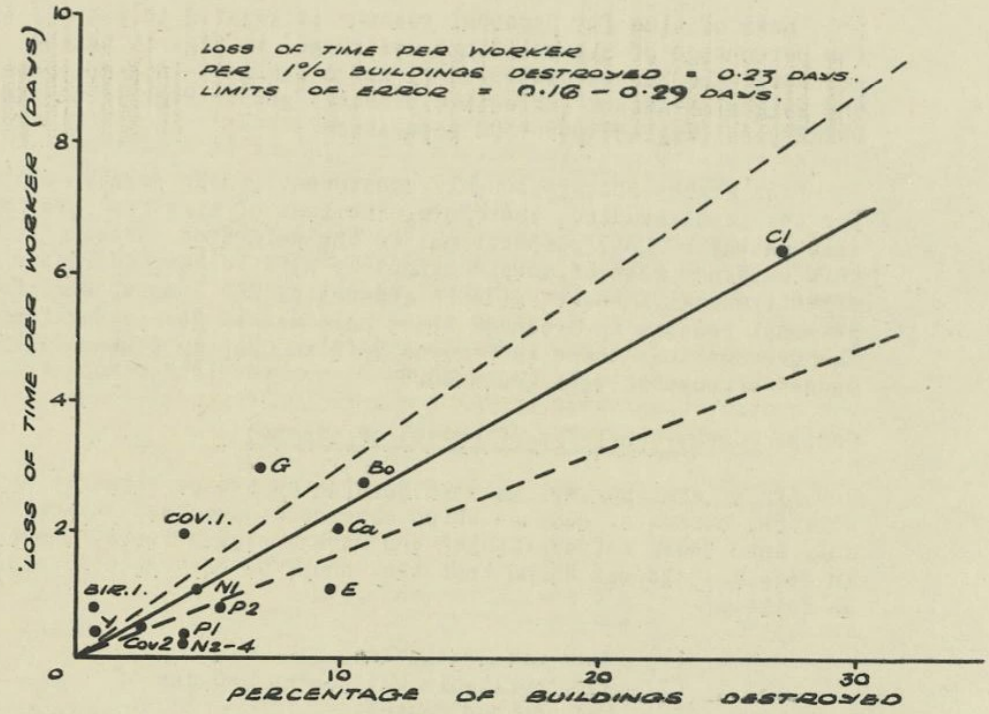
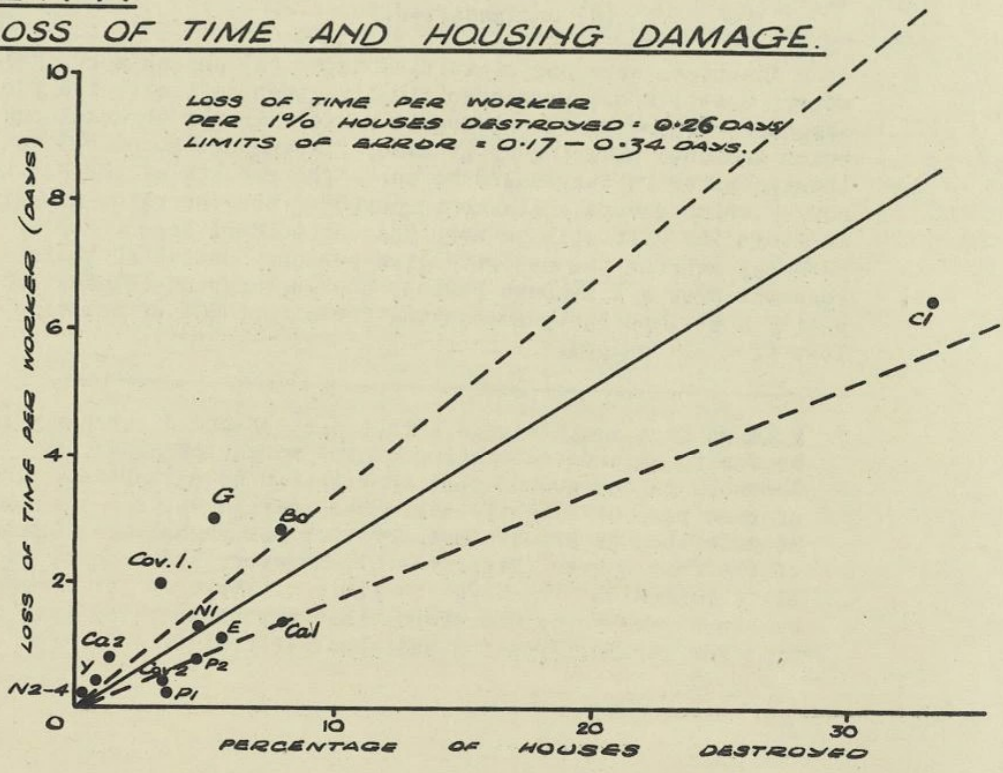


FIGURE . 14.

LOSS OF TIME AND HOUSING DAMAGE.



LOSS OF TIME FOR PERSONAL REASONS
(FOR 3 WEEKS AFTER ATTACK)

FOR MEANING OF SYMBOLS SEE TABLE 8.
THE DOTTED LINES INDICATE THE LIMITS OF ERROR OF THE ESTIMATES GIVEN BY THE CORRESPONDING FULL LINES.

FIGURE . 15 .

LOSS OF TIME AND DENSITY OF ATTACK.

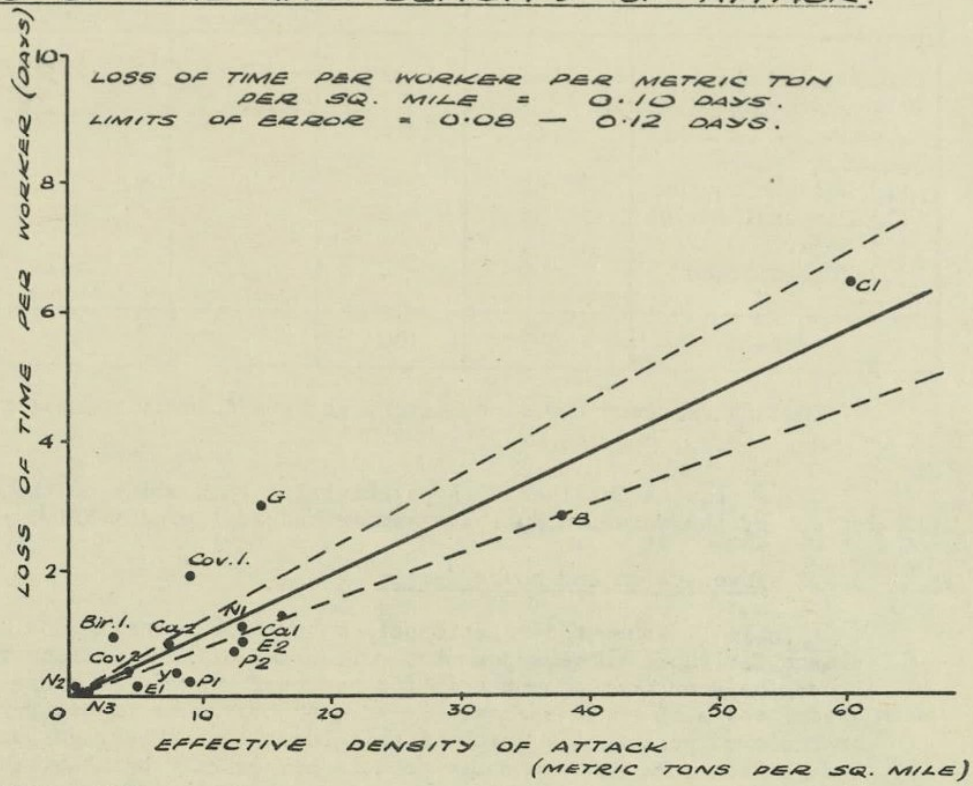


FIGURE . 16 .

LOSS OF TIME AND CASUALTIES.

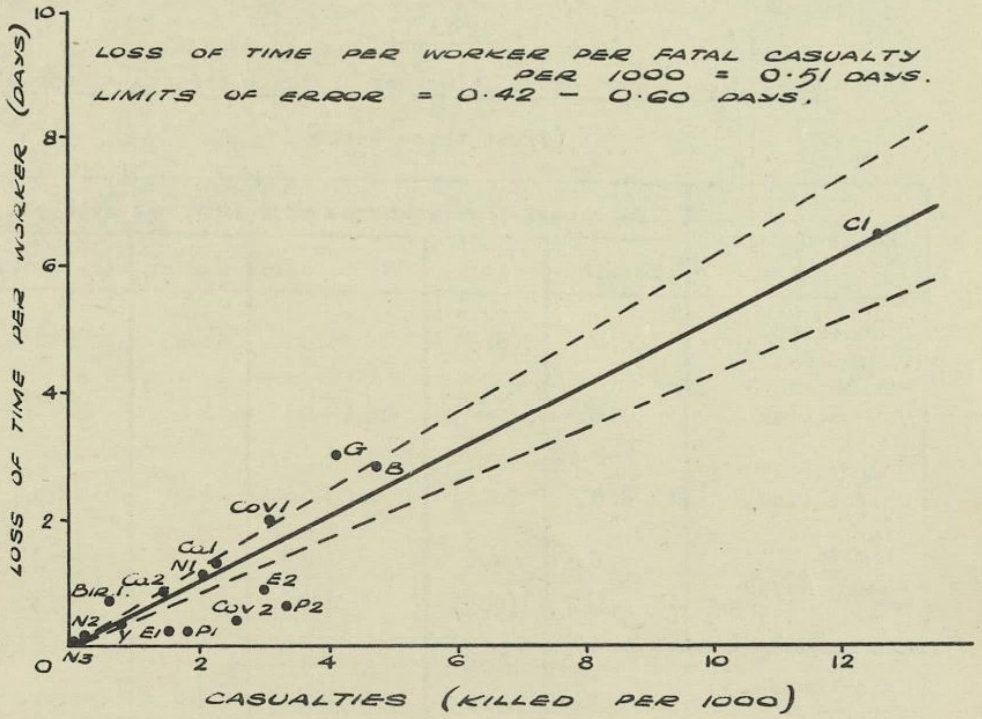


TABLE 26

Norwich - Analysis of time lost for "other causes" than "work not available"

(six-months period)

Cause	No. losing time	% of all absentees	Days lost per absentee	Equivalent days lost for all workers
Work not available	120	32	17.4	2.3
Work available but absent for personal reasons, viz:-				
(a) Nervous causes	87	23	22.1	2.1
(b) Personal duties	158	42	2.7	0.5
(c) Injury	4	1	22.5	0.1
(d) Unclassified*	6	2	3.5	nil
Total	375	100	-	5.0

* Includes absence for such reasons as breakdown of transport.

The results obtained by a psychiatrist in a study of the effect of the raids in Hull are summarised in Appendix XII.

6.2.3 Absenteeism and house damage

Table 27 shows the relationship between absenteeism and house damage for those workers for whom work was available in four towns. It can be seen that absenteeism for personal reasons is closely associated with house damage. A worker whose home is destroyed or rendered permanently uninhabitable loses on the average about 6 days from work and one whose home is temporarily uninhabitable loses 3 days. Much of this loss can be attributed to the need to find alternative accommodation either inside or outside the town.

TABLE 27

House damage and loss of time for personal reasons - four towns

(First three weeks)

House damage	Days lost per worker to whom work was available				
	Norwich	York	Canterbury	Exeter	All towns
Demolished (A and B)	6.4	(8.5)	5.3	4.9	5.8
Permanently uninhabitable (C_b)	(3.2)*	6.0	(6.4)	6.1	5.6
Temporarily uninhabitable (C_a)	4.4	(0.5)	3.5	1.9	2.9
Slight damage (D)	1.6	1.0	1.2	1.2	1.3
Nil	0.4	(0.2)	0.2	0.5	0.3
Total Loss for P.R.	1.1	0.4	1.3	0.9	1.1

(* Figures based on fewer than 5 workers are in brackets).

6.2.4 Absenteeism and population movements

Table 28 shows the relation between absenteeism and movements and for comparison gives the results separately for the different damage categories of the houses in which the workers were living. The greatest absence was among workers living in A, B and C_b houses, as shown also in Table 27. Among workers living in the slightly damaged or undamaged houses most time was lost in connection with evacuation, and to a much smaller extent, with movement in the town. It is notable that except for workers in the heavily-damaged houses no more time was lost by those trekking than by those living and sleeping at home. These results indicate that when workers leave the town absenteeism becomes serious, but a nightly movement out of the town causes little increase in loss of time.

TABLE 28

Association between absenteeism and movements - all towns

(First three weeks)

Type of movement	Loss of time per worker (days)		
	A,B,C_b	C_a,D	Undamaged
Evacuation	4.9	5.9	2.7
Trekking	(8.3)*	0.9	0.2
Movement in town	5.9	1.4	1.4
Living and sleeping at home	(1.0)	0.7	0.2
Total loss per worker	5.5**	1.4	0.3

* Figures based on fewer than 5 workers are in brackets

** Reference to the comparable figures for A + B and for C_b damage in Table 27 shows that this figure is probably low as it should lie between the 5.6 and 5.8 of Table 27. As the difference is small, however, it is of little consequence and is retained.

6.3 Reduced efficiency of those returning to work
The Norwich Shoe Industry

6.3.1 Introduction

The Norwich shoe industry provides exceptionally detailed information on production and labour, and the effects of the air raids can consequently be studied in detail.

Two basic operations in shoe-making are "cutting" and "closing". Cutting or "clicking" is a straightforward process, carried out by men and demanding considerable skill, but it is one not likely to be affected by delays in other phases of production. It consists in cutting out from the skins all the pieces of leather that go to make the uppers of a pair of shoes, either by cutting round template patterns by hand, or by using knives shaped to the required patterns which are placed, one at a time, on the skin and then driven through by a special power press. Skill is shown in placing the templates or knives so as to secure the maximum economy of leather.

The work of the "closing" department which assembles the uppers, includes on the other hand, a complex sequence of operations, carried out by women on special machines and it demands skill of the type necessary to operate sewing machines. The operations of the cutting and closing departments were chosen as providing the best indices of the productivity of the firms.

Just before the raids the industry was employing 6,500 operatives, nearly half of all factory workers in Norwich. For most of the firms daily figures are available for the number of pairs cut and the number of pairs closed and daily figures are available for workers actually attending for work, but in a number of firms the sexes are not recorded separately.

Three undamaged firms have provided daily figures for the numbers of workers attending in the cutting and closing departments.

Although the figures have certain defects of detail, they, nevertheless, provide a very valuable index of the weekly and daily fluctuations, and it is possible not only to obtain an indication of the general trend of production, but also to see how the efficiency of workers attending for work is affected by air raids. They may also be used to check the accuracy of the results provided by the survey.

6.3.2 Variations in production

Fig. 17A shows the number of pairs of shoes cut and the number closed each week from April 20th to August 31st, 1942 for the 23 firms for which figures were available and which cover 98% of the shoe industry in Norwich.

Raids affected production in three separate ways:-

1. By destruction of factories and machinery.
2. By causing absenteeism from undamaged factories.
3. By lowering the efficiency of those attending for work.

Fig. 17A represents the total effect of all three factors.

It will be seen that after the raids of 28/30th April total production did not fully recover till the third week in June. A further considerable fall occurred after the raid of 1/2nd August.

The capacity before the raids was estimated at 500,000 pairs per month, somewhat above the permitted output of 453,000 pairs per month but the actual output even before the raids was, owing to shortage of labour, about 430,000 pairs per month, somewhat below the permitted output.

In the period April to August, 1942 three firms lost all their buildings and plant, and this reduced the total potential capacity to about 420,000 pairs a month. Five other firms also suffered, but since their machinery was not destroyed they repaired the damaged buildings or, as in one case, moved to new ones. The policy of the Ministry of Labour and National Service of reducing the number of workers in the industry was probably an additional factor leading to slow recovery, for the raids provided an opportunity of diverting displaced workers to other industries.

One noticeable feature of Fig. 17A is that after the April raids and for a period of over a month the number of pairs closed remained well below the number of pairs cut. This is in part an indication of the greater disturbance of the raids on female labour, and in part a consequence of the time lag in the starting up of the different departments in damaged factories. It is discussed in more detail below.

No such difference between numbers of pairs cut and pairs closed occurred after the August raids. These raids were almost entirely incendiary, and the reduction in production was due to destruction of factories. This provides another indication

that incendiary attack on the scale experienced, does not in itself cause much absenteeism for personal reasons or affect the efficiency of the workers.

The daily production figures for the period April 20th to May 22nd (omitting Saturdays) for the five undamaged firms which provided figures for male and female labour separately, are shown in Fig. 18A. The output of these firms comprised about one-half of the production of all undamaged firms. The rapid recovery of numbers of pairs cut in undamaged factories compared with those closed will be noted. Fig. 19A gives the similar daily production figures for the damaged firms.

6.3.3 Labour employed by the industry

Fig. 17B shows the actual labour force attending for work in each week in the whole of the industry. Figs. 18B and 19B give the daily labour for the five undamaged firms and the damaged firms respectively and in Fig. 18B males and females are shown separately. From Fig. 17B it will be seen that there was a considerable temporary drop in the actual labour force employed in the industry as a result of the April raids, and that there was a permanent loss in labour of about 10%. Figs. 18B and 19B show that the permanent loss was confined to the damaged firms. Fig. 18B also shows that females in the undamaged firms took considerably longer to return to work than males.

6.3.4 Loss of efficiency of those attending for work

A rough measure of overall efficiency may be obtained by taking the mean of the number of pairs of shoes cut and the number of pairs closed as an indication of the general output of the factory, and calculating the ratio of this to the number of workers employed. In the case of the five undamaged firms the separate ratios of number cut to male labour and number closed to female labour are taken. The results are shown graphically in Figs. 17C, 18C and 19C. The daily figures shown in Figs. 18C and 19C are subject to the qualification that there has been some carry-over from day to day and this results in certain irregularities in the results. In particular, the apparent efficiency on the 29th April, shown in Fig. 18C, the second day after the first raid, is probably too high.

Fig. 18C shows that the apparent efficiency of the male labour in the undamaged firms was little affected by the raids, whereas that of the female labour was considerably depressed for a day or two, and showed a slight depression for the ensuing fortnight, though whether this was a real effect of the raids is uncertain.

It will be seen from Fig. 19C that the apparent efficiency of the damaged firms was very seriously depressed during the first week after the raids, but that it had reached its original value by the third week after the raids, and subsequently showed an apparent increase over this value. This rise, however, was not genuine and was due to the restarting of firms which had had their factories and stocks of partly-finished shoes destroyed. The cutting and closing departments were the first to start, labour for the subsequent operations not being taken on until required. Some trace of this effect is also shown in Fig. 17C.

A more detailed study of the efficiency of male and female labour is possible in three undamaged firms which provided figures for the labour employed in the cutting and closing rooms covering five weeks. The daily figures of output are too much affected by carry-overs from one day to the next to be worth reproducing, but the weekly means seem reasonably reliable. These average outputs per unit of labour are shown in Table 29.

FIGURE. 17.

NORWICH SHOE INDUSTRY.

ALL FIRMS

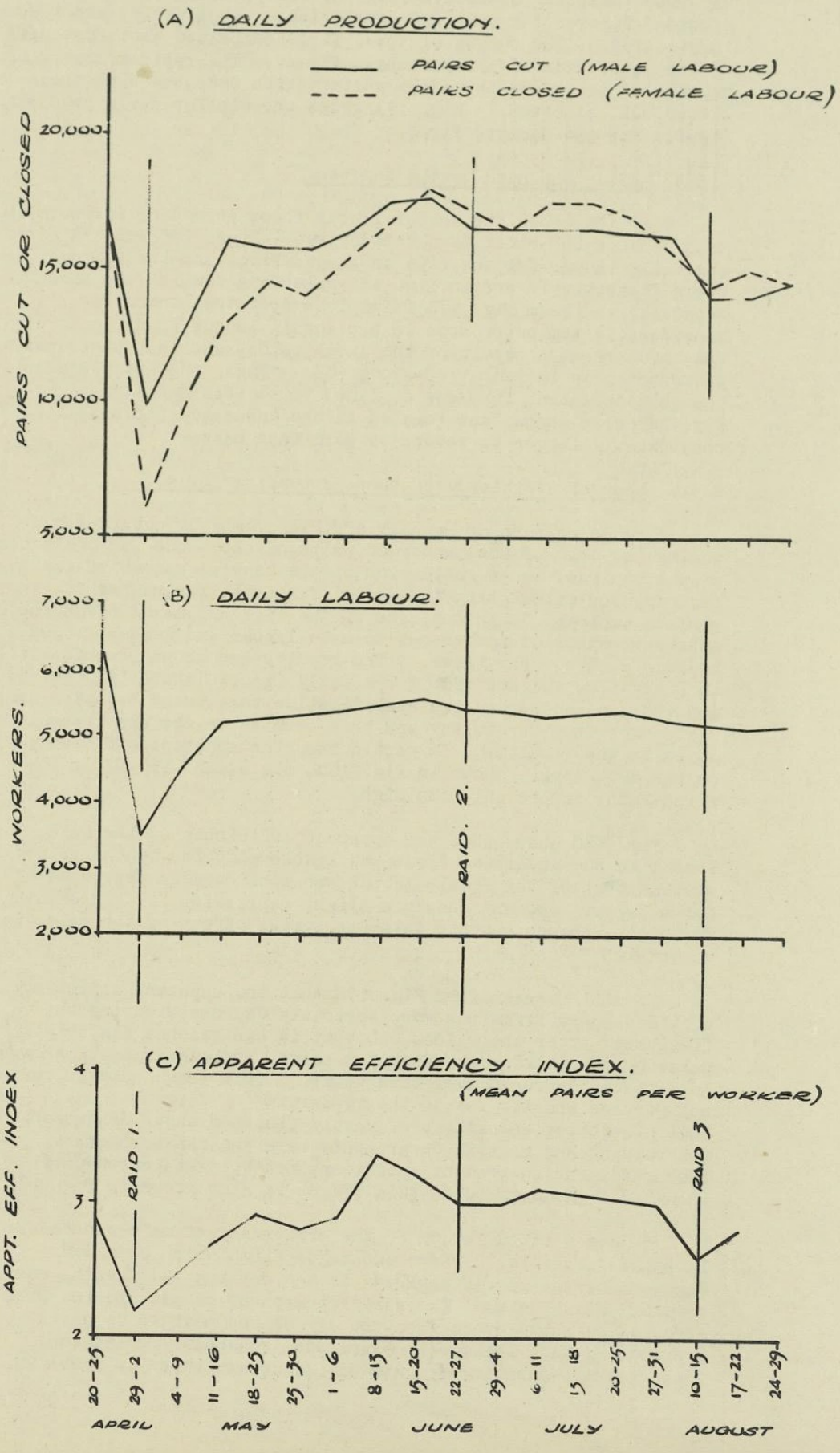


FIGURE. 18.
NORWICH SHOE INDUSTRY

(FIVE UNDAMAGED FIRMS : C.W.S., HOWELL & WHITE., BATSON & WEBSTER., KIRBY., WITTON)

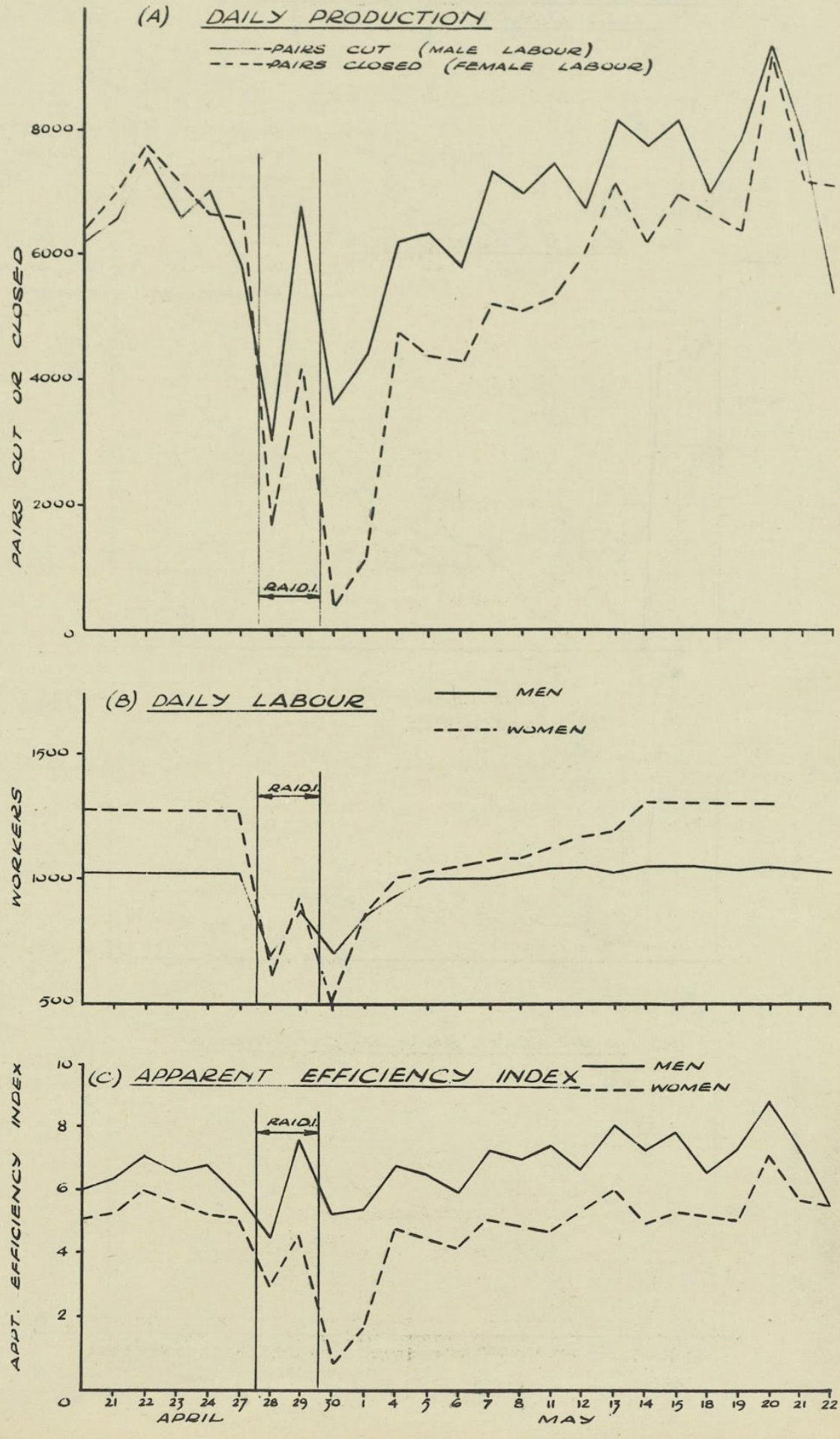


FIGURE . 19 .
NORWICH SHOE INDUSTRY
ALL DAMAGED FIRMS

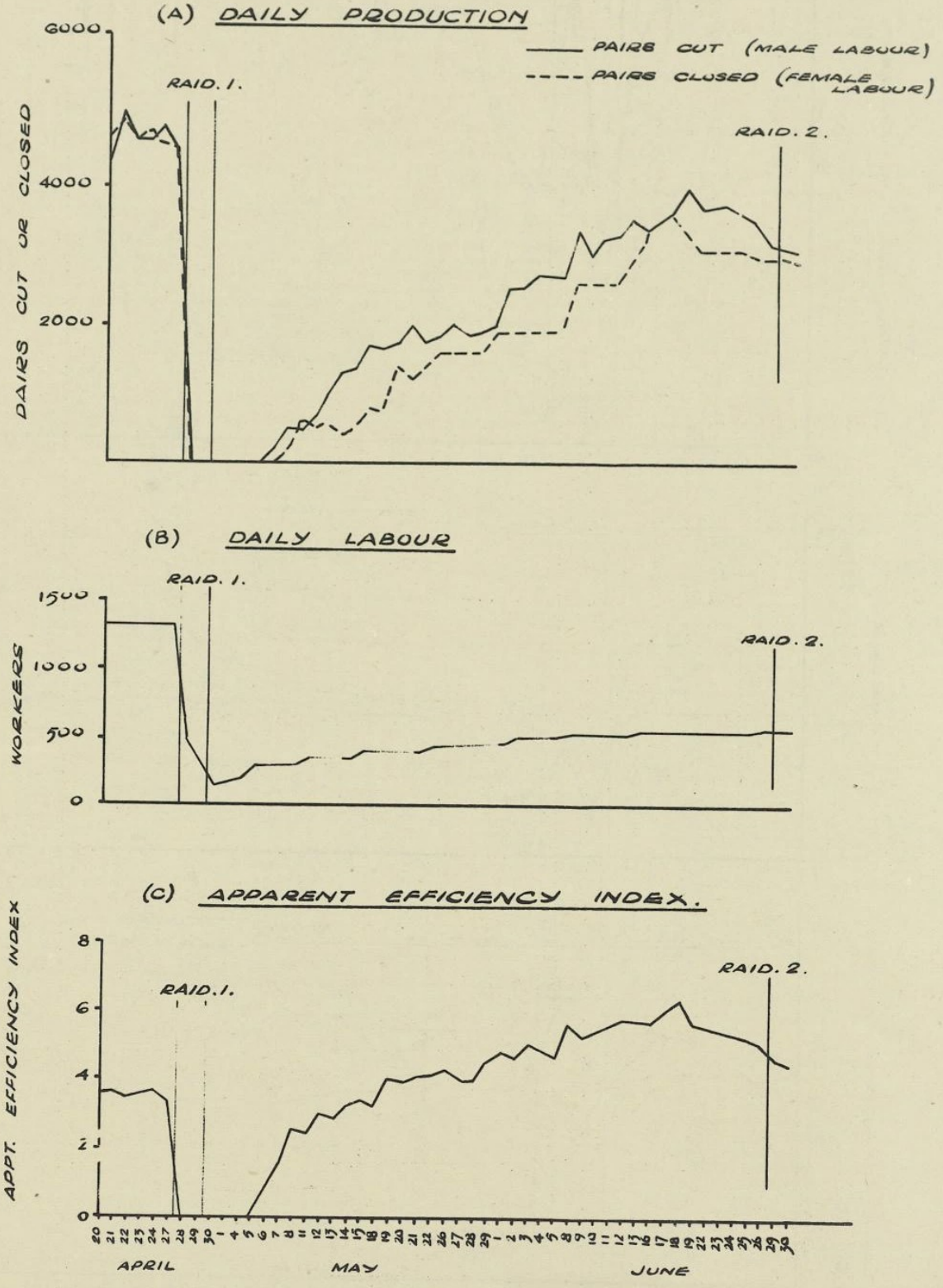


TABLE 29

Norwich Shoe Industry - Efficiency of workers after the April raids

(3 undamaged firms)

Week ending 1942	Cutting department: Output per man (pairs per day)					Closing department: Output per woman (pairs per day)				
	Firm				% of pre-raid	Firm				% of pre-raid
	1	2	3	All		1	2	3	All	
25 April	21.6	29.5	26.4	26.3	-	7.7	8.7	13.9	9.3	-
2 May	26.2	37.5	24.2	26.5	101	7.7	7.3	3.6	6.0	65
9 May	22.3	26.9	35.6	26.1	99	8.8	9.8	10.2	9.5	102
16 May	25.3	28.6	43.5	30.0	114	7.6	9.8	12.6	9.2	99
23 May	21.3	25.2	43.3	27.2	103	8.5	9.8	13.6	10.0	108

It will be seen that the efficiency of the cutting rooms employing male labour is apparently not appreciably affected by the raids. The average efficiency of the closing rooms employing female labour, on the other hand, showed a drop of about a third in the raid week, but had completely recovered in the next week. This drop, however, was entirely due to loss of efficiency in one firm, and the average loss of efficiency to be expected cannot therefore be assessed with accuracy. The causes of this loss of efficiency are somewhat obscure, but were attributed by the firm to "morale". Nevertheless the fact that the average apparent efficiency in the raid week in the five firms shown in Fig. 18C which includes firms 1 and 3 of Table 29 but not firm 2) was similar to the value obtained in Table 29 (62% as compared with 65%) provides a general confirmation that considerable, but temporary, loss of efficiency is likely to occur, for one cause or another, in a complex production process employing female workers.

6.3.5 Loss of production caused by the raids

The total loss of production caused by the raids can be estimated from the difference between the actual production in each week and the production in the pre-raid week. Table 30 shows the results of this calculation for the first two 3-week periods after the April raids including the raid week. Undamaged and damaged firms have been tabulated separately. The results are given in terms of working days lost, taking 6 days to the week.

TABLE 30

Norwich Shoe Industry - Loss of production

(Days)

	Cutting Dept.			Closing Dept.		
	Undamaged firms	Damaged firms	All firms	Undamaged firms	Damaged firms	All firms
1st 3-week period	2	15	5	6	16	9
2nd 3-week period	nil	9	2	1	11	4
Total (6 weeks)	2	24	7	7	27	13

Over the whole industry the production losses in the closing departments were about double those in the cutting departments while for the undamaged firms the contrast is even more marked.

That part of the production loss which is attributable to lost time can be assessed from the labour figures in a similar manner to the total production loss. The results for the five undamaged firms for which details of male and female labour are available separately, are shown in Table 31.

TABLE 31

Norwich Shoe Industry - Loss of production in days of cutting and closing departments of five undamaged firms

(First 3-week period)

Loss of Production	Cutting Dept. (Male)	Closing Dept. (Female)
Loss due to absenteeism *	1.4	3.4
Loss due to inefficiency	0.4	2.5
Total production loss	1.8	5.9

* The figures for absenteeism are calculated for the total male and female labour.

The same comparison can be made for the three firms of Table 29 using the actual labour in the cutting and closing departments only. The results are shown in Table 32.

TABLE 32

Norwich Shoe Industry - Losses of production in days in cutting and closing departments of three undamaged firms

(First 3-week period)

Loss of Production	Cutting Dept. (Male)	Closing Dept. (Female)
Loss due to absenteeism	1.6	4.0
Loss due to inefficiency	nil	1.1
Total production loss	1.6	5.1

Were it not for the high variability between the three firms this table would provide a better measure of the additional loss due to inefficiency than would Table 31. On the whole it seems likely that the results given in that table somewhat overestimate the proportion of the total loss ascribable to inefficiency and disorganisation. Some firms may, for example, have transferred labour to other departments temporarily in order to clear up as much partially-finished work as possible.

In the case of the damaged works it is not possible to evaluate the additional loss due to disorganisation owing to the fact that the labour figures cover all the departments in the factories, and cutting and closing were restarted before finishing.

As a generalisation, the additional loss of production in undamaged factories may be assessed at 10-50% of that directly attributable to absenteeism, the lowest figure being applicable

to straightforward processes employing male labour, and the highest to complicated processes involving a large number of operations by different workers and employing female labour.

In the case of damaged factories similar additional losses may be tentatively assumed. The actual additional losses will of course vary greatly with the nature of the damage; if a factory is completely destroyed there will be no additional loss in that factory over that given by the labour figures. Re-absorption of the workers into other factories will, however, involve losses due to inefficiency while the workers are learning their new jobs and being fitted into the organisation and these losses will be additional to the total time lost from work. This may easily amount to 50% of the time actually lost.

There is one further factor to be borne in mind when assessing the disorganisation due to interference with labour in a complex process such as the production of shoes. Different stages in the production may get badly out of step and readjustment may take some time. This is shown in the present case by the way the cutting operation got ahead of the closing as shown in Fig. 17A and Table 29.

Thus assessing the total loss on the mean of the numbers of shoes cut and closed a total loss of $4\frac{1}{2}$ days is obtained for the undamaged firms whereas the closing departments themselves actually lost 7 days. Whether the leeway is made up depends on such factors as inter-changeability of labour, loading of machinery and ability to work overtime. In general, it may be assumed that in the case of minor disturbance due to labour only, the leeway can be made up without much further loss of efficiency. If this is the case the long term loss in the undamaged firms of the shoe industry may be assessed at $4\frac{1}{2}$ days.

In the case of actual damage to factories the same situation often arises in a much more marked form, since one stage of the production process may be entirely interrupted. This may be expected to be reflected in the labour figures, however, since labour in departments in which work is not available will usually be laid off.

Singer Manufacturing Co. Ltd., Clydebank

The following discussion is based on records of the Singer firm in Clydebank which was considerably damaged in the raids of the 13/14th and 14/15th March 1941.

6.3.6 Production per worker-hour in the needle department

While in most departments the heterogeneity of products prevented measuring of productivity by the number of articles turned out, the needle department was one in which the number of operations performed provided a good measure of productivity. Records were available showing the number of needles that passed through each principal stage of the productive process in each week; productivity was counted in terms of these operations rather than in needles finished in order to prevent the weekly output figures from being biased by changes in relative emphasis between the earlier stages of production and the finishing operations. Even among needles, normal output per productive worker-hour differs according to the type of needle, but Singer's have indicated that the relative proportion of different types produced did not vary substantially during the months preceding and following the March 1941 raids. Hence, the number of operations per productive worker-hour fairly indicates the effect of the raids on worker efficiency in the operation of automatic or semi-automatic machines - the typical job in this department.

The needle department suffered only such minor damage as broken windows. Electric power, however, was lacking for most of the first week after the raids, and those workers who attended were engaged on the clearance of debris in other departments.

TABLE 33

Singer's, Clydebank - Productivity in the needle dept. before and after the raids

Period	Productive worker-hours (thousands)	Operations performed (millions)	Operations per productive worker-hour
Pre-raid - 2 weeks ending 12th March	42.4	49.0	1156
Post-raid - 2 weeks 17th March - 2nd April (lower efficiency)	28.0	28.9	1032
Post-raid - week ending 9th April (efficiency regained)	18.7	21.9	1171

(The figures for post-raid periods of productive worker-hours, are obtained after the deduction of losses due to time spent in repairing damage, increased idle or waiting time, etc.)

Table 33 indicates a decrease of about 10% of productivity per productive worker-hour for about two weeks after the resumption of production and serves to confirm the view expressed by an executive of Singer's that the decrease throughout the plant was small. A loss of output equal to about 0.2 of a pre-raid week's production resulted, although this would be somewhat higher if the loss of output due to increased idle time caused by temporary dislocations were also included.

While the efficiency of many individuals, particularly female workers, was undoubtedly lower, the average loss was kept down because the workers most seriously affected by the raids remained away from work, while many of the more efficient workers operated a larger number of machines than normal during this period and thus brought up the average. This applies generally to those departments in which automatic and semi-automatic machine operations were important.

In other departments such as the foundry, forge and tool shop, where automatic machinery was of less importance, almost all the workers were male and included a large proportion of thoroughly experienced workmen, whose efficiency was little affected by the raids. Hence, in these departments also, the loss of efficiency was certainly not greater than the needle department figure of 10% for two weeks.

6.3.7 Length of the working week

From the available data it appears that the raids did not reduce the number of hours which workers were prepared to work. The figures on which this statement is based are given in Table 34.

TABLE 34

Singer's, Clydebank - Hours worked per week

1941 4-week periods ending	Average number of workers	Total hours worked (thousands)	Hours per worker per week
8 February	7,022	1,378	49.1
8 March	7,216	1,449	50.2
24 May	6,908	1,369	49.5
21 June	7,068	1,448	51.2
30 August	7,272	1,500	51.6
27 September	7,478	1,522	50.9
25 October	7,589	1,508	49.7
22 November	7,661	1,582	51.7
20 December	7,800	1,603	51.4

(Raids occurred on 13/14 and 14/15 March)

This indicates that the average week worked by Singer employees, after an interval of a few months after the March, 1941, raids, was longer than it had been before the raids. This suggests that the raids did not for any prolonged period make Singer employees unwilling to work overtime.

The increasing proportion of munitions to sewing machines in Singer's output may have led to increased willingness to work overtime. Certainly it was not due to the proportion of male workers as this became lower after the raids than it was before.

6.4 Absenteeism for personal reasons as a measure of morale

Table 29 shows that there was no appreciable loss of efficiency by male workers at Norwich but that the efficiency of female workers dropped by about a third during the week following the attack. At Clydebank, for which separate figures for male and female labour are not available, there was a general loss of efficiency of 10% in the fortnight following attack which, assuming about equal proportions of men and women, is roughly the same loss as at Norwich. It appears very doubtful whether loss of efficiency by female workers can necessarily be regarded as evidence of loss of morale however defined although loss of morale would probably result in loss of efficiency. The particular interests and responsibilities of women workers, many of them wives and mothers with parents and children at home, together with their attitude to their work which most of them regard as temporary employment only, mean that, apart from any question of morale, their reaction to air attack would be greater than that of men workers. Neither Norwich nor Clydebank, where the efficiency studies were carried out, suffered excessive absenteeism for the weight of attack nor were they regarded as suffering any loss of morale. It is unfortunate, therefore, that similar studies could not be carried out at those towns, Greenock, Coventry and Birmingham, which did suffer excessive absenteeism and some loss of morale. Thus it is not possible to relate loss of efficiency directly with loss of time for personal reasons or with loss of morale. On present evidence it would seem best to accept loss of efficiency following an air raid as a natural and inevitable failing of female labour under those conditions with no implication as to the state of morale.

Figures 13 to 16 give the relations between loss of time for personal reasons and the four indices of effectiveness of attack and show that there is for each index a mean ratio which represents the expected loss of time for personal reasons under air attack. This may be taken as a practical measure also of the mean state of morale

as it directly affects the war effort. When the ratio for a specific attack significantly (in the statistical sense) exceeds the mean ratio, i.e. when in Figures 13-16 the point falls above the dotted lines, it may be said that the town attacked suffered a loss of morale just as if it falls below these lines the morale of a town may be said to be definitely high. Further, when a town, here Greenock, shows the greatest relative increase on the mean value, for all indices of effectiveness of attack, it may be said that Greenock, of those towns studied, suffered the greatest loss of morale. Thus the state of morale (as it directly affects the war effort) of each town may be compared with that of other towns and with the mean.

There is evidence in official reports that in those towns, Greenock, Coventry and Birmingham, which are considered to have suffered a loss of morale in the restricted sense discussed above, there was a temporary but definite loss of public confidence and of morale in the general sense. In Appendix XIII an attempt is made to determine the state of morale from the public press and it is shown that a correlation exists between loss of time for personal reasons and lack of public confidence. This supports the view that loss of time for personal reasons is a valid measure of public morale.

7. ABSENTEEISM AND LOSS OF PRODUCTION

7.1 Loss of time in damaged and undamaged works.
7.2 Relative importance of loss of time, reduced efficiency and material damage.
7.3 Conclusions.

7.1 Loss of time

(a) Undamaged works

Production in undamaged works will be affected not only by actual loss of time by the workers, but also by the lessened efficiency of those who do attend, either because of effects on the workers themselves or because of disorganisation of the productive processes due to non-attendance of other workers. In certain cases also work may be stopped owing to interruption of power or other services although the works are not themselves damaged.

Apart from stoppage of work due to lack of power, which would usually result in the workers being placed in the category "work not available", this loss of time will be equivalent to the loss of time for "personal reasons" as given by the survey. The loss due to lessened efficiency will be variable, depending on the type of worker and the complexity of the production process. For example in the study of the Norwich shoe industry in Chapter 6 cutters were found to suffer no loss of efficiency, but the closing departments staffed by women suffered an additional loss of output which averaged 50% of the loss of time, although this loss varied greatly from works to works.

Similar studies were carried out in the Singer works at Clydebank. In the bullet-core department there was an actual increase in output per man during the week subsequent to the raids, because more machines were run per worker than was normally the case. This production process, however, is somewhat exceptional in that it is a single process conducted on automatic machines, and the governing factor in production is the number of machines which can be kept in operation.

In Singer's needle department which suffered no damage apart from broken windows, the output per productive worker-hour was only reduced during the first two weeks after the resumption, with a loss in efficiency amounting to less than 10%. This is roughly 20% of the loss of production attributable to time lost for personal reasons. The assessment is based on the number of operations per productive worker-hour, which was considered by the firm to be a fair indication of the efficiency achieved in the operation of automatic or semi-automatic machines, the typical job in this department.

From this somewhat scanty evidence, and from general considerations, it may be concluded that the loss due to lessened efficiency in undamaged works is never likely to be large and it may be tentatively assessed at about 25% of the actual loss of time during the first 3 weeks after the raid.

No allowance has been made for loss of time due to shortened hours, or for the failure of workers to work overtime. The only information on this point was obtained from Singer's records, which show that the Clydeside raids did not reduce the number of hours which workers were prepared to work (Table 34).

(b) Damaged works

For damaged works, the loss of time given by the survey will be by no means a full measure of the total loss of production. A stoppage at one stage of the production process may result in a piling up of stocks of partly-finished goods which are only slowly re-absorbed; damage to machines may result in the adoption of less

efficient processes and there may be diversion of workers to clearance and repair work. The situation will also depend on whether the available plant in the industry as a whole is working to capacity, or whether surplus plant is available in undamaged factories. In the latter case, labour may be transferred immediately from the damaged factories, while in the former it will be necessary to reconstruct the plant before production can be restored. Nevertheless in the latter case surplus labour may be temporarily utilised elsewhere, so that it is not wholly wasted.

In Singer's, output in all the important engineering departments was restored, but in the wood-working and other minor departments production was permanently reduced. The total loss of production in the engineering departments is estimated to average 19 days per worker made up as follows:-

Loss of time	9 days
Time spent on clearance	7 days
Loss due to lessened efficiency	3 days
Total	19 days

It should be emphasised that though Singer's is a very large firm with 7,000 workers, it was at that time working on many unrelated contracts, so that disorganisation of one section of the works did not necessarily hold up production in other section of the works did not necessarily hold up production in other sections to anything like the extent that would occur in a factory producing a single product involving all departments. Nevertheless the estimated total loss in production was more than twice that attributed to loss of time.

7.2 The relative importance of loss of time, reduced efficiency and material damage

The amount of material damage in a factory depends very much on the nature of the factory attacked, and in particular on whether it is particularly susceptible to fire. In the case of Singer's although interference with production in the engineering departments was largely attributed to H.E. damage, most of the material damage was the result of fire, and much was due to destruction of stocks of various kinds. The actual amounts of material damage in Singer's and in a number of factories involved in isolated raids made with H.E. only, are shown in Table 35 below. Under the heading of damage to buildings, only that damage is included which it has actually been necessary to repair during the course of the war. Of the loss of machinery and stocks, it may be assumed that in the group of 10 factories the majority of goods falling under these headings required replacement, though at Singer's, due to the transition from peacetime to war production, the replacement of most of the machinery and equipment was deferred.

It will be seen that the total material damage to buildings, plant and stock per metric ton of H.E. on the 10 factories is somewhat less than the loss of production, while in Singer's, where there was extensive fire damage to stocks but none in the engineering shops, the loss due to material damage was substantially greater than the loss of production.

A similar assessment may be made in the case of bombs falling in residential areas. From Fig. 14 it may be calculated that the total loss of time for personal reasons per metric ton of bombs falling on a residential area with a standard population density of 43.6 per acre, of whom 40% are workers i.e. with 11,150 workers per square mile, during the first 3 weeks after the raid is 0.095 x 11,150 = 1,060 man days. A 25% addition must be made to this to allow for loss of efficiency. There will be a subsequent "adjusted" loss of a further 530 man days in the next 3 months, and a similar loss of 530 man days over the remainder of the 2 year period.

TABLE 35

Factory losses per metric ton of H.E.

	10 factories (H.E. only)		Singers (H.E. + Fire)
	On buildings	On site *	On site
Production loss	£33,600	£11,200	£24,700 (largely H.E.)
Buildings (replaced or to be replaced)	£19,500	£6,500	£30,500 (largely fire)
Plant and machinery	£7,600	£2,500	£31,200 (largely fire)
Stock	£3,700	£1,200	£59,800 (largely fire)
Total	£64,400	£21,400	£146,200

* Assumed 1/3 built-up for comparison with Singer's.

Conversion of man-day losses to money values must take into account the fact that a proportion of the workers are engaged in work of a special kind such as building which makes little use of productive plant. Time lost in this case has less significance than that lost by workers whose inactivity involves also the stoppage of machinery and the plant. A conversion factor of £1.25 per man-day has therefore been taken, and the resulting figures are given in Table 36.

TABLE 36

Effect of 1 ton of H.E. bombs on a fully built-up residential area (43.6 persons per acre)

	"Adjusted loss" (man-days)	Money "value"
Loss of working time (First 3 weeks	1320	£1,650
Loss of working time (Next 3 months	530	£ 660
Loss of working time (Next 21 months	530	£ 660
* Repairs to C and D houses		£3,000
ø Replacement of household goods - (assumed at £50 per A or B damaged house)		£ 350
		£6,320

* War Damage Commission data.
ø £50 is a minimum figure for immediate replacement of essentials.

Thus in isolated raids with H.E. only, a ton of bombs on a factory area has roughly three times the effect of a ton of bombs on residential areas, even if there is no fire damage to the factory.

In assessing the total effect of these categories of damage on the war effort, however, priorities must be taken into account. Generally speaking, repairs of housing will be given a much lower priority than repair of factory premises and plant. The priority of the latter will depend primarily on whether any surplus capacity of the required type is available elsewhere or not. If it is not, then the repair may have high priority if the goods made in the factory are themselves of high priority.

The amount of repair and reconstruction to housing will also depend on the extent of the damage. With very severe local damage the amount of money spent per damaged house may be considerably greater than when there is slight damage, both because the proportion of lightly-damaged houses will be lower, and because pressure on the housing of the locality will compel repair of the more severely-damaged houses.

7.3 Conclusions

The foregoing figures put into perspective the effects on the war effort of absenteeism caused by air raids of the scale of attack experienced. If the necessary replacements of plant, stocks, and factory buildings are taken into account, for the same weight of H.E. direct damage to a factory appears to cause about six times as much loss as the absenteeism caused by damage in residential areas. Damage in residential areas also necessitates repair to housing, but this only amounts to roughly one-sixth of the total effect of damage to a factory, even assuming equal priority in repairs. The true measure of the effect of house damage on the war effort is obviously less than this (perhaps of the order of 1/10 or 1/20) unless the housing position is so acute that house repairs and factory repairs are given an equal priority. The total effect of a given weight of H.E. in factory areas, therefore, will be about 4 to 5 times that in residential areas.

The use of incendiary bombs, however, introduces a new factor, since the vulnerability of a town and its associated factories affect the results.

8. DISCUSSION AND CONCLUSIONS

8.1 Weight and effectiveness of attack.
8.2 Movements of population.
8.3 Loss of time from work.
8.4 Loss of efficiency.
8.5 Loss of production.
8.6 Morale.

8.1 The Weight and Effectiveness of Attack

The scale of air attack made against the eleven towns and cities of which surveys were made, varied from an effective density of about 60 m.tons/square mile at Clydebank to 0.3 m.tons/square mile for one raid on Norwich. The German raids on this country, which took place in the first half of the war, cannot be strictly compared with those made by the Allied Air Forces against Germany from early 1944 onwards. The German attacks against British cities were spread in some cases over the greater part of each of several successive nights, whereas the later Allied attacks delivered an equivalent or greater density within one hour. The concentration of attack and the higher proportion of I.B.s used against Germany resulted in a greater degree of damage by fire than in this country, culminating in a few cases in fire storms and great loss of life.

The comparisons made in this paper show that for the scale and kind of attack experienced in this country, the time factor is unimportant and the total weight of an attack, irrespective of how long it took to deliver, determined its effects. But this is unlikely to be true for a brief attack of very high intensity, when, with defence services saturated, fire damage, and probably casualties, would be relatively high. The effectiveness of attack would in that case probably be best measured by the percentage of buildings destroyed or by the number of fatal casualties; the effective density certainly and percentage of houses destroyed probably would give too low a figure.

The reliability of the determinations of the effectiveness of attack varies for the different indices and for the different towns. This is particularly true of effective density of bombing as the full Bomb Census only came into operation for the later attacks and some of the figures given here are particularly suspect. For this reason conclusions are only drawn in respect of individual towns when any quantity (e.g. percentage movement of population) is, say, abnormally high in respect of all indices and not of one or two only.

8.2 Movements of Population

Population movements are broadly divided into two classes, movement outside the town (evacuation and trekking) and movement within the town. Movement outside the town is shown to be, in general, directly proportional to the effectiveness of attack and the percentage of the population moving is three times the percentage of houses destroyed (A + B damage) and thirty times the percentage of fatal casualties.

The percentage of population evacuating depends mainly on the percentages of houses destroyed and damaged and on whether the town is surrounded by an urban or country area. There is a greater proportion of evacuation when the raided town is surrounded by open country than when by other urban areas.

There appears to be a change in the pattern of population movements as the percentage of house damage increases. With from 5% to 10% of house destroyed about 10% of the population evacuate, 10% trek and 10% move elsewhere in the town but as the percentage of

house destruction increases the percentage evacuating increases rather more than in strict proportion, movement within the town does not appreciably increase and trekking, after rising to about 20% with 15% to 20% of houses destroyed, declines rapidly. It seems that those willing or able to do so evacuate with comparatively low percentages of houses destroyed (for example, about half of those evacuating from towns with 5% houses destroyed came from D damaged or undamaged houses) but as the percentage of damage increases the tougher elements remaining are forced out by lack of accommodation or of work.

When workers evacuate, even to places within daily reach of their work, absenteeism becomes serious but it is surprising to find that trekking causes little loss of time; in fact, save for workers whose homes were damaged or destroyed, no more time was lost by trekkers than by those living and sleeping at home. Further a report by a psychiatrist (Appendix XII) implies that workers of nervous temperament may do better work when trekking than when staying at home.

8.3 Loss of time from work

Loss of time from work for all reasons other than those unconnected with the raids, such as sickness, is shown to be, in general, directly proportional to the effectiveness of attack, measured by any of the four indices. The loss of time during the first three weeks following an attack is, on the average, 0.37 day per worker per 1% of buildings destroyed; 0.40 day per 1% of houses destroyed; 0.15 day per metric ton/sq.mile dropped (effective density) and 0.81 per fatal casualty per 1000 population. The loss of time during the first 16 weeks following attack is given by multiplying the above values by a factor of $1\frac{1}{2}$ and that for a period of about 2 years by multiplying them by a factor of $2\frac{1}{2}$. The tables in Appendix IX which give the loss of time for the various industrial groups in the eleven towns studied show that, in general, least time was lost by transport workers and by those in government service. It would also appear from evidence in Chapter 6 that industries employing a high percentage of women are likely to lose more time on that account.

Time lost from work may be divided into two parts, that lost for no fault of the worker because work is not available or because of injury and that lost because the worker absents himself for personal reasons. For the scale of attack suffered by this country, time lost for personal reasons is also shown to be, in general, directly proportional to the effectiveness of attack, however measured. Loss of time for personal reasons, during the first three weeks after attack, is on the average, 0.23 day per worker per 1% of buildings destroyed, 0.26 day per worker per 1% of houses destroyed, 0.10 day per metric ton/square mile (effective density) and 0.51 day per fatal casualty per 1000 population. Examination of Table 18 shows that the same factors, $1\frac{1}{2}$ and $2\frac{1}{2}$, for the 16-week and 2-year periods would probably also apply in the case of time lost for personal reasons although this is not specifically stated.

A worker whose house is demolished or rendered permanently uninhabitable loses, on the average, 6 days and one whose house is rendered temporarily uninhabitable 3 days, much of which time can be attributed to the need for finding alternative accommodation.

8.4 Loss of Efficiency

A study of the Norwich shoe industry shows that, for the scale of attack experienced, men workers lost little if any efficiency after a raid whereas women workers lose about $\frac{1}{3}$ of their output during the week following the raid but have completely recovered in the following week. This result accords closely with that obtained from the records of the Needle Department of Messrs. Singer at Clydebank which show that 10% of productivity per productive-worker-hour was lost over the first two weeks following the raid, which it

is of interest to note, was the heaviest of those studied in this paper. Loss of efficiency, however, was undoubtedly restricted because those workers whose efficiency was most likely to be affected were absentees. The Singer records also indicate that the average number of hours worked rose slightly after the raids and willingness to work overtime was thus not affected by the raid.

8.5 Absenteeism and loss of production

Air attack may cause loss of production by direct attack on factories or indirectly by attacking workers' homes with consequent absenteeism and reduced efficiency on the part of those who do attend. Comparative study of the effect of equal weights of bombs dropped on factory and on residential areas shows that, assuming no widespread damage by fire, the monetary loss in the former case would be 4 to 5 times that in the second. This takes account of loss of time and lessened efficiency of workers in both cases, replacement of the factory buildings, equipment and stock but assumes that while C and D damaged houses would be repaired, A and B damaged houses would not be replaced. Taking into account replacement of factory buildings, plant and stocks the monetary loss would be six times as great as that due to absenteeism caused by an equal weight of bombs on the residential area from which the workers came. These comparisons have been made on the assumption that damage has been caused mainly by H.E. Fire damage on a large scale would upset these conclusions as the figures for damage to Singer's plant clearly show.

8.6 Morale

It has already been pointed out that the state of morale of workers as it directly affects the war effort may be measured by the amount of unnecessary absenteeism on the part of the workers. As the intensity of attack mounts it is clear that an increasing number of workers will require time from work for the essential tasks of salving their possessions and finding new accommodation, and thus there is a rate of absenteeism related to the intensity of attack which carries no implications as to the state of morale. This average rate of absenteeism for personal reasons per unit effectiveness of attack has already been given. If, however, in a specific town the rate of absenteeism is abnormally high it follows that, since more time is being lost from work than is normally taken up by personal duties following an attack, the town has suffered a loss of morale. Similarly, if the rate of absenteeism is abnormally low in another town, it indicates that workers are hurrying back to their benches and desks immediately their essential personal duties have been performed and morale in that town may be said to be high. Thus the ratio of the absenteeism for personal reasons to the effectiveness of attack suffered by a town may be taken as a rough measure of the state of morale of that town.

Of the towns and attacks studied in this paper, the attack on Greenock and the first attacks on Coventry and Birmingham, all show abnormally high rates of absenteeism for personal reasons, significantly greater than the mean value for all the towns and attacks and thus these towns may be considered to have suffered a loss of morale.

The local press in a number of the surveyed towns is studied in Appendix XIII and it is shown that the amount of criticism of local C.D. services, administration and so forth correlates more highly with absenteeism for personal reasons than with any of the indices of effectiveness of attack or with absenteeism from all causes. Thus excessive criticism which represents a loss of public confidence, which in turn is one aspect of loss of morale, conforms with excessive absenteeism for personal reasons and provides evidence that the latter may be used as a measure of morale in the wider sense as well as in the narrow sense originally adopted in this paper. There is

evidence also that a loss of public confidence actually existed in Greenock, Coventry and Birmingham at the time.

From the study of the local press in relation to morale (Appendix XIII) it appears that a reasonable amount of criticism of local authorities is normal and even desirable and that only when the amount of this criticism differs markedly from the mean for the amount of damage in the town may any conclusion be drawn as to the state of its morale.

APPENDIX I

SOCIAL SURVEY METHOD

So much publicity has been given lately to surveys of opinion that one is in danger of forgetting that they represent only a limited aspect of the work of social surveys. Indeed one cannot help feeling that the general interest in public opinion has hurried investigators into methods of which the validity is by no means established. The opinion of a community, in any meaningful sense, is not arrived at by summating the views of its members on the basis of one vote each. People's views do not fall simply into the do's, the dont's and the doubtful's, and any experienced interviewer knows that a householder who has no opinion will, with a little encouragement, quickly get one.

People are sometimes astonishingly unaware even of the things which touch upon their daily lives and a wife may be ignorant of her husband's occupation, of the form of transport he uses and of how long it takes him to reach his work. The material upon which accurate information can be collected in social surveys based on interviews is limited, as limited as people's memories, powers of observation and interests. It seems advisable, therefore, to explore these limits on questions of fact before venturing into the much more difficult field of opinion. What can it mean to discuss the future world with an individual who has not made the most primitive observations about the present?

There is great need of a work which will indicate the nature of the material which can be collected by the social survey interview, and which will demonstrate the limitations and difficulties involved.* Unfortunately nothing so ambitious can be based on the present experience, which was concerned primarily with a single, if complex, problem, and which necessitated comparable studies in several towns. At the same time it has been thought worthwhile to make some use of the material for this purpose, and in this note certain general conclusions are drawn from the investigators' experience.

1. The selection of interviewers

No quality is so important in a field worker as personal honesty. A slow worker can collect fewer facts, and a less intelligent worker simpler ones, but the dishonest individual can collect nothing worth having. Further, since results are pooled, a single unreliable investigator can invalidate the work of a whole team.

It may seem unnecessary to make this point unless attention is drawn to a few important features of fieldwork. First, it is physically most exhausting. Random samples, while reducing immeasurably the total work, do necessitate visits separated by considerable distances. The interviewer may arrive at the top of a long flight of stairs only to discover that the occupants have removed to half-way across the town, or in other cases to learn tantalizingly that they are now living in the street where the last visit was made. The difficulty is not so much that the investigator is tempted to invent the answer, though this sometimes happens, but rather that in the circumstances he may accept an alternative source of information without questioning its validity. There are many cases in survey work in which it is necessary to accept information given by neighbours about the household in the sample and often its value can only be judged by the fieldworker, but it is of the greatest importance that the

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* Dr. Yates has recently published a book which in part serves to meet this need. It is "Sampling Methods for Censuses and Surveys", published by Charles Griffin, 1949.

decision to accept or reject such data should be made honestly, and should not be influenced by fatigue, nor by the need to increase the number of successful interviews completed in a day.

There can be no greater mistake than to make the number of completed interviews the index of a worker's value. Yet in some enquiries of this type it has been customary to offer a bonus for each call above a fixed number. Such a practice is certain to force the kind of decision referred to above, and to lower the standard of work. Even with tested observers the number of interviews completed varies considerably from day to day according to the season, the weather, the shopping hours and so on. Of course, over a period the number tends to be fairly constant, and is undoubtedly related to the speed and strength of the individual. But the greatest caution is needed in assessing these features early in an enquiry, and never for a moment should the fieldworker be made to feel that he is being judged by the number of successful visits. The one way to ensure that each member of a field team does his best work is to make certain that he understands thoroughly the purpose of the enquiry, and there is no better way of doing this than to use the field staff for the statistical treatment of the data. This question is discussed more fully later.

In the course of the present survey 22 field workers were used, although by far the greater proportion of the work was done by 6 of them. Those engaged were selected in the beginning chiefly on the basis of previous experience. The candidates for the work were perhaps not typical of peacetime, since during the war a considerable number of women look for employment differing from that in which they would normally be engaged. Table 37 gives an analysis of the qualifications and value of the 22 fieldworkers; it should be emphasised that this is an analysis of the workers actually engaged and not of those offering themselves for employment. It is for this reason that so few failed for health reasons, since care was taken to select persons likely to be able to stand the arduous work.

Although the number of interviewers engaged was not large, certain general conclusions can be drawn. It will be seen that of the 22 workers selected, only 10 were satisfactory. Perhaps the most striking fact is that women were very much better than men, since 9 of 15 were suitable, as compared with only 1 of 7 men. It is unlikely that these figures would be the same in peacetime, but it is safe to say that for house-visiting women are better than men, of whom the householder tends to be suspicious. Nor is it surprising that it is easier for a woman to interrupt the housewife in her day's work with a list of questions, than for a man who is traditionally regarded as less aware of her problems.

The table also makes it clear that previous experience is no guarantee of a worker's value. Of 6 women rejected as unsuitable, 4 had been employed before in social surveys, as compared with 3 experienced women among the 9 who were satisfactory. Indeed 3 of the best field workers were without any specific academic training, and had done no survey work of any kind. 5 of the 9 however held a University degree or diploma in social science. Only 1 of the 6 unsatisfactory women was similarly qualified.

The most frequent reason for disqualification was personal dishonesty, sometimes of the elusive type already referred to, but not infrequently resulting in quite flagrant deception. This was particularly striking among the men. It is probable however that in peacetime a different type of man would be available, men trained and interested in social work, and not offering themselves merely because they have failed to settle at anything else.

TABLE 37

Qualifications of field staff engaged in the social survey

Field worker	Sex	Previous experience in field work	Academic training			Value as a fieldworker			
			University degree or diploma		No specific academic training	Satisfactory	Unsatisfactory because of:		
			In social science or psychology	In any other subject			Personal dishonesty	Lack of intelligence	Health reasons
1	F	+	+			+			
2	F				+	+			
3	F				+	+			
4	F		+			+			
5	F				+	+			
6	F		+			+			
7	F				+	+			
8	F		+			+			
9	F	+	+			+			
10	M	+		+		+			
11	F	+					+		
12	F	+	+				+		
13	F	+						+	
14	F	+						+	
15	F				+			+	
16	F				+		+	+	
17	M				+			+	+
18	M			+			+		
19	M				+		+		
20	M			+			+		
21	M				+		+		
22	M				+		+		
		7	6	3	10	10	8	5	1

On this experience it seems reasonable to draw the following conclusions:

(a) Women are, on the whole, more satisfactory than men.
(b) A university degree or diploma in social science is a definite advantage - possibly because it indicates an interest in the work. Excellent work is, however, done by enthusiastic persons who have had no such training.
(c) There is no indication that previous experience, at least of the kind that the staffs available today have had, is of much use.
(d) Having regard to the exhausting nature of fieldwork there is no doubt that workers should be young (preferably under 35) and physically strong.

2. The sample

A few years ago Rowntree* made a survey of all the working class homes in York. In the analysis of his material he showed that on many points random samples would have given results not significantly different from those obtained from the whole. Indeed were this not so the time and cost required for such work would be prohibitive. It is necessary therefore to choose a random sample of adequate size, and to conduct the investigation in such a way that the original sample is strictly adhered to. In house visiting there is a not uncommon practice of giving up after three unsuccessful visits (where the occupants are found not to be at home), and this is certain to prejudice results. Where necessary the times of interviewing must be adjusted, and often calls on Saturday afternoons and in the evenings are needed. If certain interviews are still unsuccessful all that is necessary is to recognize that a smaller sample has been used and that this sample may be slightly biassed owing to the exclusion of special units.

In some investigations no attempt is made to select a random sample, and conclusions are based on overheard morsels of conversation and haphazard interviews. Instances are quoted such as "The first taxi driver was heard to say" or "The last person to leave the shelters stated", as though there were something specially significant about the first or the last opinion which relieved one of the obligation of examining the rest. It is for the worker to prove the validity of his results, and it is fair to say that in this type of investigation that proof is lacking.

Some control of the material for study is necessary if a random sample is to be selected at all. One can prepare in advance a sample of households in a town or of workers in a factory, but not of individuals in a street. Of course it is possible to stop every tenth or hundredth person passing a certain point but this will not necessarily give a random selection even of those people in the street. The questions which can be studied in this way must be very limited, for the street, a shop, or the post-office are hardly suitable places in which to enter into complex discussions with strangers. Furthermore it becomes extremely difficult to adhere to the sample. The investigator may hesitate to approach an unpleasant looking individual, he may be refused by another in a hurry, or may be so delayed by one interview (e.g. with a deaf person) that he may not be ready for the next. The practical difficulties are therefore very great. This is not to say that all results obtained in this way are useless; where the question asked is very simple, and where almost everyone holds the same opinion, a non-random group of answers will still be representative.

For most purposes the two most satisfactory places at which to conduct an interview are the home or the place of work. The second needs the cooperation of the management, as well as of the

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* "Poverty and Progress" by B.S. Rowntree, Longmans, Green, 1941.

workers themselves, through their representatives, the shop-stewards and trade unions. Social investigations in factories have the advantage that it is sometimes possible to correlate the results with figures on, say, production and attendance. This paper, is however, based on interviews made at the homes, and it is for these that the methods are discussed in detail.

3. The institution of an enquiry

If a house survey is to be carried out in English towns it is essential to secure the cooperation of the local authority and of the police. In a government investigation such as the present this is not difficult, and both are ready to do all they can to assist if the purpose of the enquiry is explained to them.

The Town Clerk should be seen at the outset, and it is best for the director of the fieldwork to arrange an appointment by letter. The purpose and method of the enquiry are then discussed with him, and it is important that he should clearly understand that there are to be house-visits in his town or borough. In particular his assistance is needed for the following:

(1) To provide a copy of the electoral register, the valuation roll or other documents from which the sample can be taken. These may only be borrowed, but some Town Clerks prefer that they should be used only in the Town Hall.

(2) To arrange access to records in the possession of the local authority. Many of these are available in his own department, but he can also be of great help in providing introductions to the Medical Officer of Health, City Engineer, City Architect or other official.

(3) To provide a letter of introduction for each fieldworker of the form "Miss . . . . . is working for the Ministry of . . . . . in an important government survey, and I should be glad if you would give her any assistance that you can".

It is a considerable advantage to have letters of this type (which should always be returned to the Town Clerk at the end of the survey). Government passes sometimes mean little to the persons interviewed, and in such cases they usually like to be reassured by some document from the local authority.

The city police also should be fully aware of the nature of the enquiry, and of the names of the fieldworkers engaged in it. The Town Clerk can arrange an introduction, but frequently it is unnecessary to trouble him. The director of the fieldwork should see the chief local officer.

These initial steps take only a little time, but they are indispensable. However tactful and experienced the interviewers may be, they occasionally encounter persons who will call up the police, particularly as people are naturally more suspicious during war-time. These difficulties can be minimised if fieldworkers take the trouble to explain to the housewife before each interview the authority for the investigation, as well as to provide some brief but reasonable explanation of its purpose. The largest number of police calls of this kind in any town covered by the present investigation was three, and in most towns there were none.

These suggestions have been made on the assumption that the work is done for or authorised by a government department, and a special problem arises where such authority is lacking. Such work will inevitably be limited in its scope, especially in war-time, and may be in peacetime also if access is needed to records which involve trouble to the local authority. It may be difficult to persuade a City Architect to inconvenience himself for what appears to him to be a purely academic investigation. It is for

this reason, in particular, that we consider it so important that, wherever possible, work of this kind should be supported by a central authority.

4. Material for investigation

Experience is the best guide to the material which can suitably be obtained in an interview in the home. The test is to ask oneself "Can it be put in a question to which the person interviewed can give a meaningful answer?". Even with considerable experience it is often difficult to judge this, and the pilot survey is a useful device which enables one to test the results on a limited scale before undertaking the actual enquiry. In a pilot survey a small number of interviewers (perhaps only one) try out the questions at a few households. The experienced worker soon knows whether the answer obtained means anything, and questions answered doubtfully or only after suggestion should be excluded. Two samples will illustrate this point.

In the present investigation it was hoped to discover how much time was lost by workers in getting to and from work after raids, either because of transport delays, or because of a longer journey from a new residence. It was soon evident that many wives did not know how long it took their husbands to get to work in the ordinary way, much less by how much the time had been increased by raids. Many of them did not know the nature of the transport used. Some kind of answer could be obtained by suggesting "Was it more than 15 minutes?" or "Was it less than half an hour?". But material obtained in this way is worthless, and the question was dropped.

Another question to which replies were unsatisfactory was addressed to persons who did not evacuate and who were asked whether they would have done so had a billet been arranged in advance. This was a point of considerable importance, since the authorities argued that if they made extensive preparations to receive evacuees, they would inevitably encourage the evacuation and trekking which they wished to avoid. But it is a poor survey question; in our experience people do not reply satisfactorily to hypothetical questions about their behaviour in imaginary circumstances. They reply most accurately to questions of fact concerning their immediate experiences.

It must be remembered that the majority of interviews are conducted during the day, and that the person interviewed is usually a housewife. It is sometimes startling to learn how little a wife may know about her husband's life, and it is useless therefore to ask questions of a kind that she cannot answer. She usually knows the name of his firm (which in many cases she can only spell phonetically), is occasionally vague about his occupation, and often is in doubt about his conditions of work. There were a few women who did not know in what occupation their husbands had been engaged before the war, and one who had married a widower and who, with what seems excessive delicacy, said she did not like to ask.

Good sense must also be used in limiting the content of the interview to an amount that will neither tire the good-natured housewife nor result in a refusal from the less tolerant one. Occasional refusals occur in the best of circumstances but in a properly conducted survey they are rare and, if they are not, something is seriously at fault either in the questions asked, or in the interviewing. Most people are very willing to cooperate if the purpose of the enquiry is stated simply, although not infrequently they are mystified by the fact that their house, and not a neighbour's, has been chosen, and one may find oneself trying to explain the elements of statistics on the doorstep. One woman who had been interviewed on more than one occasion asked reasonably enough "Why do they keep on picking on me at random?". Recently an enquiry was conducted which took so much

of the householder's time that refusals were frequent, and interviewers were then advised to substitute the nearest house which would provide the information for the one on the sample. Needless to say what emerged was in no sense a random sample of the whole town, but was virtually a study of old age pensioners, the only people with the time and patience to do all that was required of them.

No reference has been made here to the very detailed enquiries which have been carried out in the United States. Some of them have involved several interviews in the same house, each lasting some hours, and supplemented by records prepared by members of the households between visits (sometimes the householder is paid to co-operate). It is difficult to assess the accuracy of the material collected. In any case random samples are never obtained in this way, since inevitably a percentage of the people approached refuse to take part in the enquiry.

5. Analysis of replies to sample question made under different conditions

The following discussion compares the results obtained by five different interviewers (A, B, C, D, E) with the same questions. Unfortunately not all five were engaged on every survey, and all the questions were not asked in every town but in each case the limitations of the data are indicated. These interviewers were known to be reliable, and any differences in the results are attributable either to the bias of the individual interviewer, or to the variability in the replies given.

(1) Age and Sex Composition, and the Percentage of Workers

Table 38 shows the percentages of females, children under 14 and workers obtained by the interviewers in several towns. The samples are not strictly comparable, since the numbers and towns studied are not identical. Even so the results are consistent, and indicate that on this type of question the social survey method is sufficiently reliable. Appendices VII and VIII give a more detailed picture of the sex and age compositions of the different towns.

TABLE 38

Sex and age composition and percentage of workers as determined by different interviewers

Interviewer	No. of towns studied	Persons in Sample	Results obtained by interviewers		
			% Female	% Children under 14	% Workers
A	6	2061	54	23	43
B	7	2417	55	23	43
C	5	1853	53	23	45
D	7	2627	55	20	48
E	7	2234	55	24	44

(2) Absenteeism

(i) Post-raid

Absenteeism presents a more difficult field. In the first place the questions are usually put to a housewife, who may not know of time lost by workers in the household. Further if the enquiry covers a period some time before the interview the exact details may be forgotten and lastly enquiries into absenteeism may be viewed with suspicion, and misleading answers purposely given.

With post-raid absenteeism these difficulties are minimal. While the effects of small raids are soon forgotten, the main ones stand out and answers are surprisingly reliable. There is no stigma attached to losing time after a raid, and in our experience absenteeism from this cause is discussed readily and without reservation. A comparison with other sources of information (see "Checks on the reliability of the survey data", Appendix V) indicates that on this question the results are fairly accurate.

Table 39 compares the results obtained by different interviewers. There is of course considerable variation in any single town, since the weight of attack (with which absenteeism is correlated) is not evenly distributed, and interviewers in the more heavily-bombed wards will naturally find a higher percentage of absentees. Even so the proportion of absentee workers found by interviewer A are low when compared with the results of the others.

(ii) Not associated with raids

The investigation of absenteeism not associated with raids raises the difficulties to which we have already referred. Such figures as are available are derived chiefly from the records of employers, and by no means answer all the important questions. It seemed worthwhile, therefore, to discover what could be learned in the field-survey, where the sample represented all the workers of the towns, and where there was some prospect of obtaining details of causes of absence. No separate investigation was made of the question, which was merely added to those with which the survey was principally concerned. It follows that the samples, of sufficient size for study of post-raid absenteeism with about 40% of workers away from work, are too small for adequate investigation of day-to-day absenteeism of the order of 5-10%. Absenteeism over three periods has been recorded:

(A) Absenteeism on the day of the interview only,
or (B) absenteeism in the week preceding the interview,
or (C) absenteeism during the 6 months preceding the interview.

The first of these is probably the most reliable. The absentees are often in the house at the time of the visit; in any case the person interviewed is usually aware of the fact if any workers are absent. The difficulty is rather that the enquiry may be viewed with suspicion, and for this reason it is more easily added tactfully at the end of the interview rather than represented as the main purpose of the visit. The sample, of course, needs to be proportionately larger if absentees on the one day only are included.

Table 40 gives a comparison between the results obtained in two towns by recording absenteeism on the day of the interview or absenteeism during the previous week. In the latter case it has been found best to include only five week days; work on Saturday is so variable that results when it is included are misleading. It will be seen, as would be expected, that the percentage of absentees is slightly greater when the enquiry refers to the day of the visit.

TABLE 39

The percentage of post-raid absentees found by different interviewers

Towns	Interviewer														
	A			B			C			D			E		
	Total workers	No. absent	%	Total workers	No. absent	%	Total workers	No. absent	%	Total workers	No. absent	%	Total workers	No. absent	%
Norwich	-	-	-	74	22	29.7	113	52	46.0	-	-	-	114	55	48.2
York	-	-	-	94	8	8.5	135	16	11.8	-	-	-	71	21	29.5
Exeter	-	-	-	131	53	40.5	-	-	-	-	-	-	79	29	36.8
Bootle	134	44	32.9	145	86	59.3	-	-	-	140	87	62.1	117	62	53.0
Clydebank	114	80	70.2	134	113	84.3	92	90	97.8	135	118	87.4	92	80	87.0
Greenock	132	99	75.0	146	102	69.8	-	-	-	168	81	48.2	101	83	82.1
Coventry	166	63	38.0	102	65	63.7	156	97	62.2	156	96	61.5	116	82	70.7
Birmingham	206	28	13.6	303	95	31.4	302	53	17.5	315	102	32.4	263	100	38.0
Plymouth 1	104	15	14.4	119	19	16.0	112	8	7.1	155	16	10.3	137	17	12.4
Plymouth 2	76	7	9.2	112	38	33.9	110	32	29.1	161	13	8.1	126	49	38.8
Grimsby 1	-	-	-	73	6	8.2	133	8	6.1	126	10	7.9	108	8	7.4
Grimsby 2	-	-	-	65	15	23.1	125	5	4.0	131	9	6.9	117	31	26.5

The table excludes workers about whom there was insufficient information.

TABLE 40

A comparison between absentee-rates as obtained in enquiries relating to the day of the interview and the previous week

Town	Date of survey	Sampling fraction	Total workers	Percentage absent daily			
				Males		Females	
				Day of interview only	Week preceding interview	Day of interview only	Week preceding interview
Plymouth	July 1943	1/73	681	3.4	3.5	1.2	1.0
Grimsby	Sept. 1943	1/50	542	4.4	3.1	5.0	4.6

A survey in Norwich by two psychiatric social workers utilised the third method of recording absenteeism during a period of six months preceding the visit. This is a useful method with the advantage that the question can more easily be asked in respect of the longer period. The data obtained are shown in Table 41; roughly 40% of male and female workers were absentees at some time during the six months.

TABLE 41

Absenteeism during the six months preceding the interview in a Norwich survey (November 1942)

Time lost during previous six months (months)	Male		Female		Total	
	Total male workers absent	%	Total female workers absent	%	Total workers absent	%
0	341	57	231	64	572	60
0 - ½	94	16	88	24	182	19
½ - 1	106	18	33	9	139	14
1 - 3	42	7	8	2	50	5
Over 3	11	2	4	1	15	2
Total	594	100	364	100	958	100

(28 workers who had been at work under six months, and one whose previous record is unknown, have been excluded.)

The difficulty of getting accurate results on questions of absenteeism by social survey methods is indicated by the comparison made of the results obtained by the different interviewers in Table 42. It will be noted that interviewer C consistently obtained a higher percentage of absentees than the others, and that interviewer A was usually lowest. With absenteeism it is the highest figure which is reliable, since persons not absent are unlikely to be recorded as absentees. Interviewer C was a psychiatric social worker of wide experience in social investigations, and her results give a measure of the extent to which the other findings understate the true figures.

TABLE 42

A comparison between the percentage of absentees recorded in four towns by different interviewers

Town	Interviewer														
	A			B			C			D			E		
	Total workers	Number absent	%	Total workers	Number absent	%	Total workers	Number absent	%	Total workers	Number absent	%	Total workers	Number absent	%
Coventry	167	13	7.8	100	7	7.0	170	24	14.1	169	16	9.5	145	11	7.6
Birmingham	185	7	3.8	285	19	6.7	295	34	11.5	278	18	6.5	236	18	7.6
Plymouth	99	1	1.0	115	5	4.3	115	3	2.6	134	1	.75	96	3	3.1
Grimsby	-	-	-	72	1	1.4	132	9	6.8	133	6	4.5	109	6	5.5
Total	451	21	4.7	572	32	5.6	712	70	9.8	714	41	5.7	586	38	6.5

In Tables 43 and 44 figures are given for absenteeism in Birmingham and Coventry, but in most of the towns studied the number of workers in the sample is not sufficiently large to justify conclusions on the proportion of absentees in different industries. Table 43 shows the percentage of workers losing one or more days during the week preceding the interview (excluding Saturday) and in Table 44 this is converted to an absentee rate expressed as the percentage of working days lost, equivalent to the percentage of workers absent daily. The results are as one would expect, that a greater percentage of female than male workers lose time, and that the highest proportion of absentees is in industry.

TABLE 43

Percentage of workers in different industries absent from work for one day or more in the week before the interview (Birmingham and Coventry)

Sex	Industrial group	Birmingham			Coventry		
		Total workers	Number absent	%	Total workers	Number absent	%
Males	Industry	760	49	6.4	578	44	7.6
	Transport	59	3	5.1	(14)	(1)	(7.1)
	Distributive trades	172	2	1.2	64	3	4.7
	Government service	74	2	2.7	47	3	6.4
	Miscellaneous	(30)	(1)	(3.3)	(8)	(1)	(12.5)
	Totals	1095	57	5.2	711	52	7.3
Females	Industry	443	56	12.6	132	29	12.5
	Transport	(22)	(0)	(0)	(4)	(1)	(25.0)
	Distributive trades	176	7	4.0	72	7	9.7
	Government service	83	4	4.8	(38)	(1)	(2.6)
	Miscellaneous	53	4	7.5	(19)	(1)	(5.3)
	Totals	777	71	9.1	365	39	10.7

(Figures based on fewer than 40 workers are in brackets)

TABLE 44

Percentage of working days lost because of absenteeism in the week before the interview (Birmingham and Coventry)

Sex	Industrial group	Birmingham			Coventry		
		Total working days	No. of days lost	%	Total working days	No. of days lost	%
Males	Industry	3800	187	4.9	2890	171.5	5.9
	Transport	295	5	1.7	(70)	(5)	(7.1)
	Distributive trades	860	8	.9	320	8	2.5
	Government service	370	6	1.6	235	12	5.1
	Miscellaneous	(150)	(5)	(3.3)	(40)	(5)	(12.5)
	Totals	5475	211	3.9	3555	201.5	5.7
Females	Industry	2215	208	9.4	1160	117	10.1
	Transport	(110)	(0)	(0)	(20)	(5)	(25.0)
	Distributive trades	880	27	3.1	360	30	8.3
	Government service	415	14	3.4	(190)	(1)	(.5)
	Miscellaneous	265	17	6.4	(95)	(2)	(2.1)
	Totals	3885	266	6.8	1825	155	8.5

(Values based on fewer than 40 workers are in brackets)

Table 45 classifies roughly the reasons given for loss of time from work in Birmingham and Coventry. The difficulties of investigating causes of absenteeism are evident and the value of statements regarding the nature and degree of illness, for example, are very hard to assess, but even were medically-qualified staff available for interviewing it is unlikely that more reliable results would be obtained.

TABLE 45

Absenteeism - reasons for losing time (Birmingham and Coventry)

Sex	Birmingham			Coventry		
	Percentage workers absent			Percentage workers absent		
	Illness		Other reason	Illness		Other reason
	acute	chronic		acute	chronic	
Males	35.1	52.6	12.3	43.1	51.0	5.9
Females	30.0	51.4	18.6	38.5	43.6	17.9

6. Period over which reliable information can be collected

In Norwich a second survey was carried out in September, 1942. It was principally intended to discover the results of the summer raids, but it also provided an opportunity for collecting data on a new sample for comparison with the results of the first survey four months before. Questions were therefore asked once again in

respect of the April 27/28, 29/30 attacks, and the results are compared in Table 46 with those obtained in the earlier surveys. It will be seen that on most points the findings are in agreement. In the case of workers absent after the raids the later survey underestimates the total by about 5%.

TABLE 46

Comparison of results obtained on the same questions by two Norwich surveys, the second carried out four months after the first and on a different sample

	House-holds in sample	Persons in sample	Work			Movements
			% workers	% female workers	% workers losing time	% workers sleeping at home on May 2nd
1st Sample	469	1349	43	41	37	68
2nd Sample	472	1374	43	41	32	69

7. The interview form

The best interview form is the simplest that will contain the data required, but considerable experience is needed to design it well. The following are some of the more important considerations.

(1) It is best to have a separate form for each interview.

(2) Headings should be brief, descriptive and not ambiguous.

(3) The questions should be placed in the order in which they can be most conveniently put. In general the simpler questions, and those which will engage the confidence and interest of the person interviewed should come first.

(4) It is more convenient not to have to use the back of a form, but if the material is too much for the front there is no real objection to it, and it is certainly better than cramping the answers for lack of space.

(5) Questions should be quite specific and not open to misinterpretation. It is tempting to have a column headed "Remarks" or "Notes", but the material under such headings is worthless, unless included as a guide to what may usefully be asked at a later enquiry. The objection to such casual observations is that one is unable to interpret them for they are not "random" in the statistical sense.

(6) The form should be arranged with its subsequent analysis in mind. If the material is to be carded, card and form should if possible be designed together in the most convenient way, so that turning over etc. is minimised. A specimen of the type of form used in the Birmingham survey is illustrated in Fig. 20 and described in Appendix II.

8. The analysis of results

It is not essential to card the material, and in the early stages of an enquiry conducted in several towns it may be difficult to do so. Analysis directly from the interview form is rather cumbersome, but has the advantage that one is not committed to the use of a card which may need to be modified. In the present survey

plain white cards were used for a time while the method was still being developed, and were found quite convenient. Eleven towns were studied, of which two were investigated twice, making in all 13 surveys. For the first five towns analysis was made directly from the interview forms, in the next four from plain white cards, and in the last four from punched cards.

A specimen of the type of punched card used in the Birmingham survey is illustrated in Fig. 21 and described in Appendix III.

It has already been stated that an ideal arrangement is to use the field staff for the statistical treatment of the data. In the early stages of an enquiry it may be difficult for anyone who has not been interviewing to know how best to interpret the results. Later if the material has already been carded by the field-team this difficulty may be overcome.

Yet even then there are good reasons for continuing to use the interviewers in the analysis. Field-work is very tiring, and after two to three weeks of heavy work a break of some weeks is desirable. But more important than this is the fact that only in this way can they be made to realise fully how their interviews are being used and to weigh the importance which is eventually to be attached to the questions they ask. Such a practice has a most salutary effect on the quality of field-work, since above all it is important that interviewers should feel that the investigation as a whole is their responsibility, and that their obligation is not discharged by filling up a form on the doorstep.

Desirable as this arrangement is, however, it may not always be practical because of pressure of work. The least that should be insisted on is that the carding should be done by the field-staff, and that each field-worker in rotation should be employed in the analysis.

9. The cost and time required for social surveys

If social surveys are to be extensively employed they must provide answers quickly, accurately, and at reasonable cost. Executive bodies frequently have to make hasty decisions, and if they cannot have the evidence before they decide they will do without it. While in many fields the scientist's tendency to work slowly, thoroughly and with little sense of time, has been invaluable, in others it has been one of the factors leading to the neglect of science. It is essential to realise that as well as the correct and final solution to a problem, there is the best answer that can be given in a week, or in a month. It is essential for the social scientist to get this sense of urgency, for without it he will find himself after the war as remote from the administrative world as ever.

All the material included in the present report was collected in a period of 15 months, by a team averaging between 8 and 10 workers. In this period they completed roughly 13 surveys in 11 towns and the total number of interviews was approximately 7500. Each survey was completed in about two weeks; Birmingham with a population of a million was the largest town studied and the survey here took 3 weeks. The material collected represents in bulk almost the limit of what can be obtained in a single interview of this kind, and since the nature of the enquiry was such that special problems of tracing householders who had removed after raids were introduced, it follows that the times quoted are, if anything, in excess of what would be needed in most surveys based on samples of comparable size. All of the analysis of the data was carried out by the same workers, who in the same 15 month period also did a certain amount of other work not reported here.

The total cost in salaries was between £3,700 and £4,400. These figures do not include the salaries of advisers, nor expenses incurred in the field (e.g. for travelling, subsistence and stationery).

APPENDIX II

THE INTERVIEW FORM

Although the forms used in the different surveys varied slightly in layout the form used in Birmingham may be taken as typical and this is shown in Fig. 20.

The notes below are given to amplify and explain the various divisions of the form and the number on the left of each note is a reference number corresponding with the one in the figure, not present on the original forms, but which has been added to simplify this explanation. It will be remembered that the raids on Birmingham occurred in November and December, 1940 and April, 1941.

1. The interviewer's name, or reference letter.

2. Name of the town.

3. Name of the ward.

4. Date of interview.

5. Number in electoral register.

6. Polling district as shown in electoral register (usually this was not recorded).

7. Address of interview.

8(a) Classification of air-raid damage.

A = Demolished.

B = So seriously damaged as to require demolition.

Cb = So seriously damaged as to be not worth repairing during the war.

Ca = Requiring temporary evacuation but to be repaired during the war.

D = Slight damage not requiring evacuation.

There were some difficulties in the classifications used. The most important arose from the fact that the local authorities were not consistent in the classification of house damage. Both A and B damage were clear enough in every town, but there was such variation in the interpretation of the various categories of C and D damage that it was impossible to make comparisons between the numbers so classified. Since the survey was concerned principally with the dwellings rendered uninhabitable at various periods it was often not possible to use the available figures for this purpose. With the help of the local authorities the difficulty was overcome by detailed consideration of the damaged houses in the sample.

8(b) Date of house damage as given to interviewer by householders.

8(c) Cause of house damage as given to interviewer by householder.
(H.E: High explosive: F: Fire).

9(a) Number of habitable rooms (excluding bathroom, scullery, attic etc.) before the raids.

9(c) Number of habitable rooms (excluding bathroom, scullery, attic etc.) at the time of the survey.

MINISTRY OF HOME SECURITY

INTERVIEWER (1) C	TOWN Birmingham (2)	WARD Harborne (3)	DATE 9-6-43 (4)	KEY (5) XYZ 123	DISTRICT (6)				
ADDRESS (7) 47 Cockle St.		HOUSE DAMAGE: CLASS (8a) D		DATE Nov (8b)	CAUSE (8c) H.E. Slight				
NO. OF HABITABLE ROOMS: BEFORE (9) 5	NOW 5	PERSONS: BEFORE 6 (10)		NOW 4	HOUSEHOLD CATEGORY (11) D				

No (12)	Status in house (13)	Name (14)	Sex (15)	Age	Injury	Present Address:- as above Movements
1	Fam.	Mrs Brown	F	YA	None	Moved to relations in Birmingham for 1 week then no further change
2	"	Mr -	M	YA	"	No change
3	"	Son -	M	J	"	" "
4	"	Daughter -	F	C	"	as 1
5	"	Baby -	F	C	"	as 1
6	P.G.	Miss Smith	F	YA	Fell April	Evacuated for 1 week to Leicester then no change till June 1942 when married and left to live elsewhere in Birmingham.
7						
8						
9						
10						
11						

WORK	AT NOVEMBER RAID		Occupation			LOSS OF TIME (23)									PRESENT (24)		
						NOVEMBER			DECEMBER			APRIL					
	Occupation	Firm and Place	Pre War (20)	Dec	Apr	Days	Cause	Code	Days	Cause	Code	Days	Cause	Code	Occupation	Firm and Place	Absent
1	X																
2	Toolmaker	Ware's Tool Co.	✓	✓	✓	2	House bombed	OC	0			0					No
3	Errand Boy	Grocer's Shop	D	✓	✓	14	Shop bombed	WNA	0			0			None	Retired (Forces)	
4	X																
5	X																
6	Clerk	Food Office	D	✓	✓	6	Evacuated	OC	0			1	Injury	INJ	None	Retired (Married)	
7																	
8																	
9																	
10																	
11																	

P.T.O.

Fig. 20a

	PRE-WAR (20)		DECEMBER (21)		APRIL (22)		ABSENT (24)	
	Occupation	Firm and Place	Occupation	Firm and Place	Occupation	Firm and Place	Days	Cause
1								
2								
3	None - School							
4								
5								
6	Clerk	Engineering. Leicester						
7								
8								
9								
10								
11								

Fig. 20b

10. Number of persons resident in houses

(a) before the raids
(b) at the time of the survey.

11. Economic classification of household as made by the interviewer.

An attempt was made to place households in five groups. No use is made of these data in the present report, but as such classifications are important it is worth describing the method used and commenting on the difficulties. The five groups were:-

A. Homes of wealthy persons with large earned or private incomes.

B. Homes of the professional classes.

C. Homes of clerks and small shop keepers.

D. Working class homes with workers in the family.

E. Homes with no wage-earner.*

The classification of households was made by the interviewers in the field, with knowledge both of the occupation of the workers and of the house in which they lived. If the occupation of the chief wage earner in each household is related to the five categories, however, the result would be:-

A.
B. Administrative and professional workers

C. Clerks
Owners of small businesses

D. Foremen
Skilled labour
Unskilled labour
Shop assistants

E. Dependent households with no workers.

It will be seen that room has been made for families with considerable private incomes (A) and for families without private means and with no wage-earner (E). Group A also contains highly-paid workers (company directors, etc.). Undoubtedly some workers in the professions have large incomes, and it is difficult to decide whether they should be placed in A or B. For most purposes it is probably best to ignore such distinctions and consider the two together, but when this is done other difficulties arise. Certain professional workers (e.g. elementary school teachers) from an economic point of view are far more closely related to the workers in C than to those in A, and if highly-paid professionals are placed with the company directors and the rest, a decision has to be taken in regard to them also. The distinction between groups C and D is also not entirely satisfactory, since many foremen and skilled labourers earn more than clerks and owners of small businesses.

---

* Households with no workers in residence but with contributing members working elsewhere or in the forces were not placed in this group, and it is not clear how they were classified.

In this classification the income is most important; but as it is not easy, and may be impossible, to get exact figures for the households other indices have to be considered. The occupation of the chief wage-earner is a useful but by no means infallible guide, for incomes vary considerably in the same occupational groups and households with several workers may have incomes which in the aggregate would (if income were the standard adopted) place them in another category than that arrived at on the basis of the chief wage-earner's occupation. There is also the difficulty of classifying households with no wage-earner.

In the future both field surveys and analyses of central statistics must make increasing use of such classifications, and it is most desirable that a common basis should facilitate comparisons, but information on incomes is difficult to collect and occupations do not provide a reliable alternative index. Furthermore, income is not the only question of importance to be considered in classifying families or households. Clerks may on the average have smaller incomes than certain classes of skilled workers, yet on standards of cleanliness, etc., may belong to a higher grade. A classification which would be satisfactory for a survey on health may be inadequate for a study of literary taste. The possibility remains, undesirable as it is, that different investigations will have to formulate and justify their own classifications.

12. Persons in the household numbered in order.

13. Status in the household. Fam. = members of one family and relatives.

P.G. (Paying Guest) = all others.

14. Names of all residents in order.

15. Sex. M = male
F = female.

16. Age. C = child (0-14)
J = juvenile (15-19)
YA = young adult (20-39)
A = adult (40-60)
O = old (over 60).

17. Injury in any raid. None
Slight = slight and untreated.
F.A.P. = treated at first aid post only.
Hosp. = treated in hospital as in-patient.
Mort. = mortuary.

18. Movements with dates, given separately for each person from the date of the first raid until the time of the survey (for classification of movements see Chapter 4).

19. Status of workers at the time of the November raid. Non-workers marked "x". The classification of workers is treated in Appendix IV.

(a) Occupation 1 = A & P = (administrative and professional).
2 = C = (clerk)
3 = F = (foreman)
4 = S.L. = (skilled labourer)
5 = U.L. = (unskilled labourer)
6 = S.B. = (owner of small business)
7 = S.A. = (shop assistant).

(b) Firm and Place. The name of the employer was often entered, but in the case of small employers where the industrial classification was evident (e.g. grocer's shop) the name was omitted. The place was also entered if outside the town, but not the employer's address within the town.

20. Status of workers before the war.

21. Status of workers at the time of the December raid.

22. Status of workers at the time of the April raid.

Where the work done at any of these dates was the same as in November 1940 a tick was entered. Where the work was different D was entered, and the nature of the work shown overleaf on 20a.b, 21a.b, or 22a.b. It was necessary to turn to the other side of the form only in exceptional cases.

23. Loss of time from work after the November (a); December (b) and April (c) raids the entry shows the number of days lost, the cause of absence, and classification of cause of absence either as:-

W.N.A. = Work not available.
O.C. = Other causes (absence of workers for whom work was available).

Workers were always classified under the heading of "work not available" if this was the original cause of absence even if they remained absent after work again became available.

24. Status of workers at the time of the survey.

(a) occupation.

(b) firm and place.

(c) absent. These data were used in a study of absenteeism not associated with raids. If the worker had lost no time in the week preceding the interview "no" was entered, if the worker had lost time "yes" was entered, and the number of days with the cause shown overleaf in 24.c.

APPENDIX III

THE PUNCHED CARD

In most of the towns studied a punched card was prepared for each worker in the sample. The type of card used was that technically known as a Cope-Chat card which has a row of holes along each edge. A specimen card is shown in Fig. 21, and is numbered to correspond with the interview form illustrated in Fig. 20. Most of the entries will be clear, but the following notes will doubtless be of assistance in elucidating any difficulties. A line is drawn through the category that applies in each case.

Work Changes:

(See front of card, lower right hand side, printed vertically)

S = Same

D = Different

A change refers to change of industry or occupation. It is therefore possible for a person to change employment without being shown as "different". All changes are referred to the position as in November. A change of occupation or industry is shown as "different". The term is however also used in a wider sense - to refer to change of status from November e.g. a November non-worker working in April is "different" in April and a November worker retired today is different today.

New Workers

(See front of card lower right hand side)

N.W. = new worker

This term includes all persons in the November household not working in November but beginning work before the April raid. Cards are made for all of these and "N.W." is punched. "N.W." includes both young people who begin for the first time and married women etc. who start to work. Workers entering the town between November and the April raids are carded, but are not shown as new workers.
Persons not working in November, but starting after the April raid, and workers entering the town after April are also carded. Workers entering the household after November from another house in Birmingham are not carded even though they are in the house at the time of the December and April raids.

Retired

(See front of card lower right hand side)

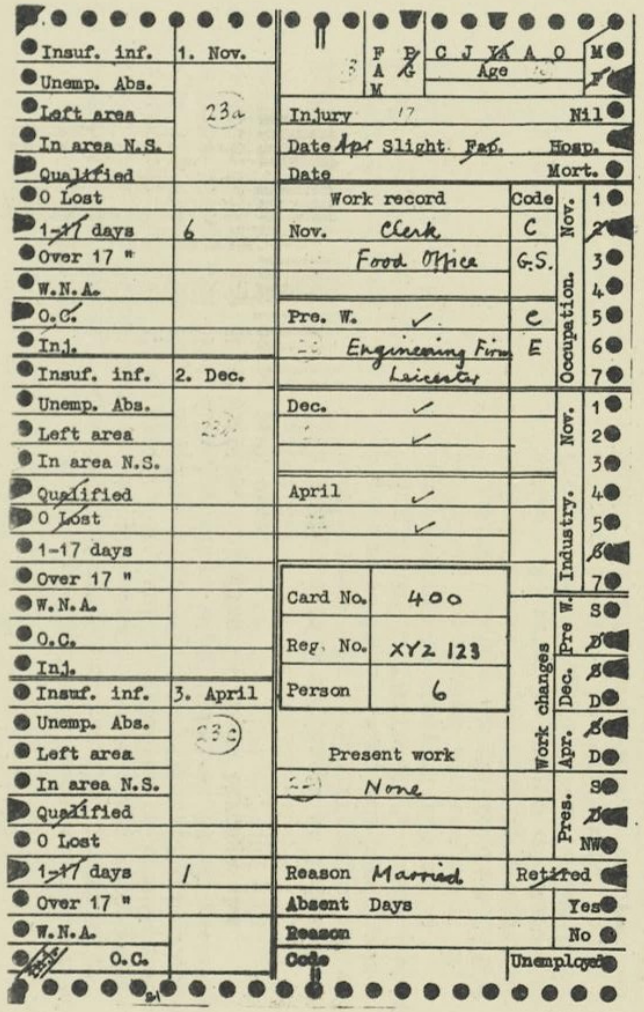
The term "Retired" includes all persons working in any of the raids, who are no longer part of the labour force of the town at the time of the survey. It includes the following:-

(a) Old people who have stopped working.

(b) Married women who have stopped working. (e.g. during pregnancy).

(c) Persons retired because of ill-health.

(d) Persons who have joined the Forces.


Insuf. inf. 1. Nov.
Unemp. Abs.
Left area 23a
In area N.S.
Qualified
0 Lost
1-17 days 6
Over 17 "
W.N.A.
O.C.
Inj.
Insuf. inf. 2. Dec.
Unemp. Abs.
Left area
In area N.S.
Qualified
0 Lost
1-17 days
Over 17 "
W.N.A.
O.C.
Inj.
Insuf. inf. 3. April
Unemp. Abs.
Left area
In area N.S.
Qualified
0 Lost
1-17 days 1
Over 17 "
W.N.A.
O.C.
F A M P G
C J YA A O
Age
M
F
Injury 17 Nil
Date Apr Slight Fat. Hosp.
Date Mort.
Work record
Code
Nov. Clerk C
Food Office G.S.
Pre. W. ✓ C
Engineering Firm Leicester E
Occupation.
Nov. 1 2 3 4 5 6 7
Dec. ✓ ✓
April ✓ ✓
Industry.
Nov. 1 2 3 4 5 6 7
Card No. 400
Reg. No. XY2 123
Person 6
Present work
None
Work changes
Pre W. S
Dec. D
Apr. D
Pres. S NW
Reason Married Retired
Absent Days Yes
Reason No
Code Unemployed

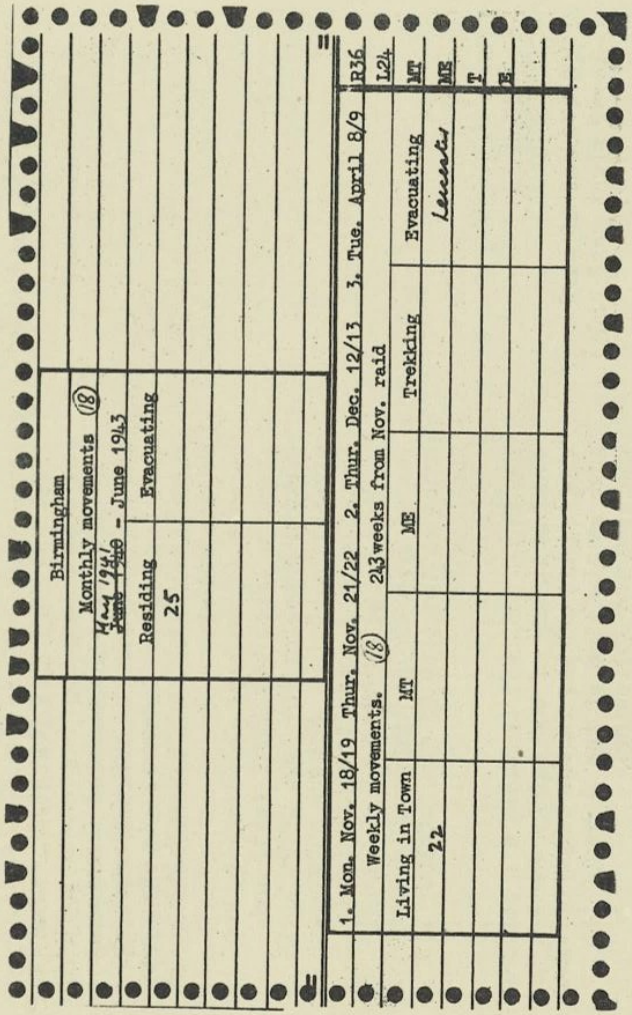

1. Mon. Nov. 18/19 Thur. Nov. 21/22 2. Thur. Dec. 12/13 3. Tue. April 8/9
R36
L24
Weekly movements. (18) 24 weeks from Nov. raid
Living in Town
MT
ME
Trekking
Evacuating
MT
ME
F
E
22
Leicester
Residing
Evacuating
25
Monthly movements (18)
May 1941 - June 1943
Birmingham

Fig. 21

(e) Persons evacuated from the area.

(f) Persons who have died.

Loss of Work

(See front of card left hand side)

In Area N.S.
= In Area None Since
(worker remains in area but has done no work since the raid)

W.N.A.
= Work Not Available

O.C. = Other Causes

If any of the first four headings ("Insufficient Information", "Unemployed or Absentee", "Left Area" or "In Area None Since") are punched, a worker is not considered to have qualified as such. Workers shown as "Left area" or "In area none since" in any raid, are not punched in any subsequent raid. By definition they have been eliminated from the labour force of the town, and no entry is needed in any later raid.
A worker losing two months after the November raid for "W.N.A." is not working in December and is punched in December as "unemployed", i.e. he was available for work but none was offered.
A worker losing two months after the November raid for "O.C." is not working in December and is punched in December as "absentee" (i.e. he is still a worker but is away for personal reasons).
If "in area none since" is punched, the original cause of absence is entered as either "O.C." or "W.N.A.".
Absences of 1 week are estimated at 6 days
" " 1 month " " " 24 "
" " 1 year " " " 288 "

Movements

(See back of card)

"23" weeks are included in the lower table (i.e. November 18 - May 1st, 1941).
"25" months are included in the upper table (i.e. May 1st, 1941 to June 1st, 1943).
These periods and dates apply only to Birmingham, and are of course different in other towns.

Government service.	Includes the post office, civil service, N.F.S., A.R.P., hospitals, local government, etc.
Miscellaneous.	Includes real estate, banks, insurance, the press, etc.

APPENDIX V

THE RELIABILITY OF THE SURVEY DATA

In certain of the towns in which the social survey was conducted records of labour were obtained from central sources in the course of economic investigations into the effects of raids. The most useful data for purposes of comparison were provided by the Norwich shoe industry, the Liverpool Port Labour Officer and Singer's Manufacturing Company in Clydebank (see Chapter 6).

COMPARISON WITH RECORDS OF THE NORWICH SHOE INDUSTRY

(a) Labour movements

Out of 161 workers in the shoe industry for whom information was available from the two surveys of Norwich the following permanent losses of workers to the industry were found:-

Undamaged firms		Damaged firms	
Other work	1	Other work	2
No work since	1	Forces	1
Died	1		
Total	6		

There was also a gain of 1 worker (a shoe-repairer whose shop and tools were destroyed).

In addition to these permanent losses the following were out of work on the 18th day after the raid, but subsequently returned to the industry.

Undamaged firms	4
Damaged firms	5
Total	9

Five workers from damaged firms transferred to other firms in the industry.

These results indicate that for the population covered by the survey there was a loss of workers to the industry on the 18th day after the raids of 14 of the total sample of 161, i.e. 9%, and that there was a permanent loss to the industry of 5, i.e. 3%. These losses may be compared with the actual losses for the week ending May 23rd of 16%, and the week ending June 20th of 11%, provided by the industry.

It will be seen that the survey has somewhat underestimated the permanent loss to the industry. This is almost certainly due to the fact that a number of workers from the damaged firms moved out of the district before the survey was undertaken and were consequently booked as untraced or as workers about whom there was insufficient information. It has been shown in 6.3.3 that there was no permanent loss of labour from undamaged firms and this is confirmed by the survey which indicates a loss of 3 workers from the undamaged firms, but a gain of 5 workers who transferred from damaged firms and 1 worker from other work. It may be concluded, therefore, that the majority of the workers leaving the industry came from the damaged firms. Some of them of course, may have transferred to similar work in other parts of the country.

(b) Loss of time

In the first Norwich survey the sample included 85 workers from the shoe industry. 64 workers lost time, the distribution being as in Table 47.

TABLE 47

Norwich Shoe Industry
Causes of loss of time reported by workers

Reported cause of loss of time	From damaged works	From undamaged works	Unclassified	Total
Works damaged	10	1	1	12
Works not operating	-	12	-	12
Injury	-	1	-	1
Personal duties, nervous causes and unclassified	-	35	4	39
Total	10	49	5	64

This table indicates that only 1 worker from an undamaged works stated that work was not available owing to damage to works but all 12 workers giving "works not operating" as the cause of absence came from undamaged works. This absenteeism must be attributed to "interference with labour", i.e. to absence of other workers on such a scale that the factory, or some departments of it, could not be operated, since all the undamaged firms were capable of working.

The day-by-day loss of time can be estimated both from the survey and from the figures provided by the industry. The comparison of these two estimates from the five undamaged firms for which male and female labour can be separated is shown in Fig. 22. In constructing the graph, the workers reported as losing time owing to damage to works and the one case of injury have been excluded. The day on which loss of work began was not recorded in the survey, but only its duration, and it has been assumed that half the workers started to lose time on the day of the first raid and the others on the day of the second raid. It will be seen that the agreement of the two estimates is very satisfactory. Discrepancies are in fact no larger than those to be expected from sampling errors.

The total losses of time over the three weeks calculated from the survey may be compared with the losses from the labour figures for the five firms already given in Table 31. This comparison is shown in Table 48.

TABLE 48

Norwich Shoe Industry - Comparison of losses due to absenteeism calculated from the survey and from labour figures for five firms

(Days)

	Males	Females	Mean
From the survey	2.0	3.1	2.6
From labour figures	1.4	3.4	2.4

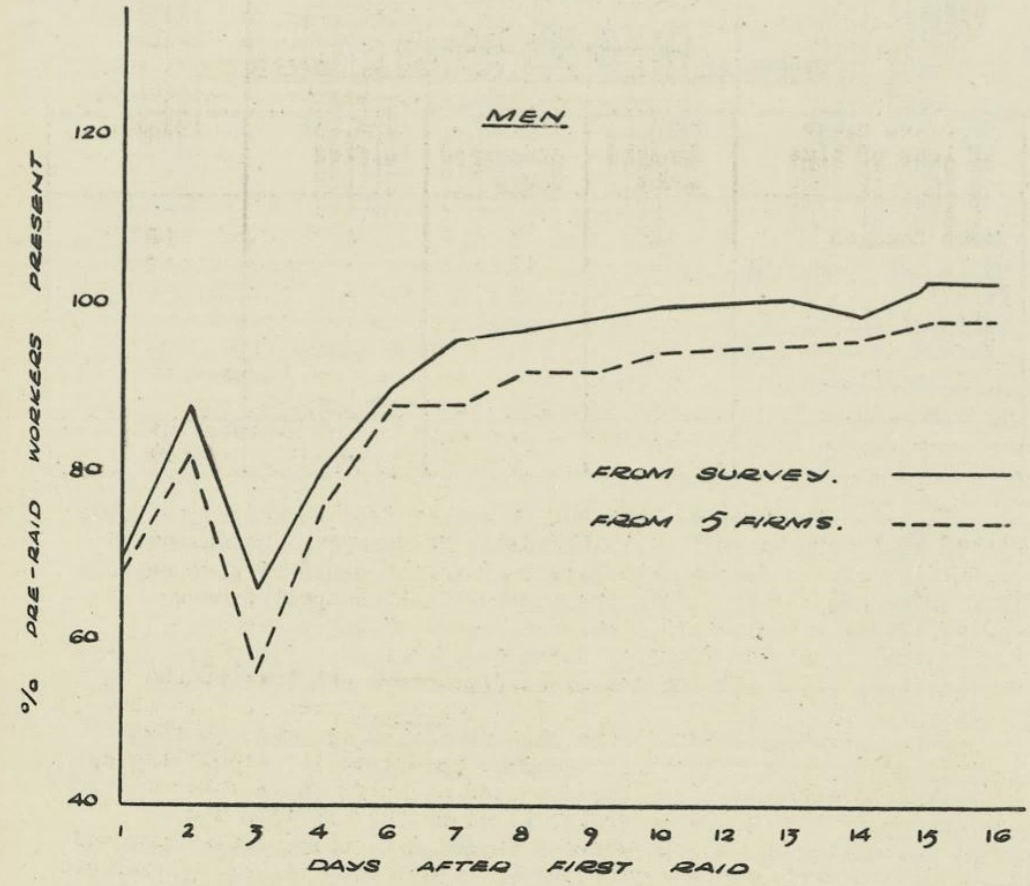
The agreement is quite satisfactory. The standard error of the estimate from the survey is 0.4 days, and the actual discrepancy is 0.2 days.

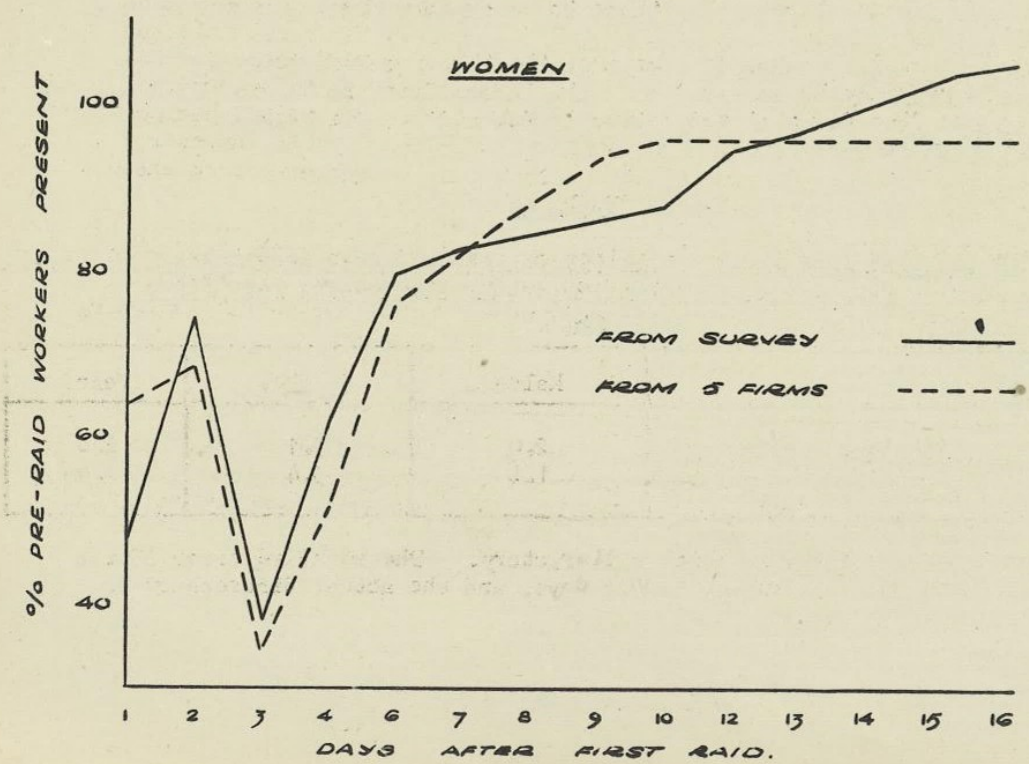
FIGURE. 22.

NORWICH SHOE INDUSTRY

COMPARISON OF DATA FROM SURVEY & FROM 5 UNDAMAGED FIRMS.

LABOUR ATTENDANCE





These comparisons show that the information provided by the workers themselves regarding loss of time due to air raids is substantially correct, and that the methods followed in the survey in collecting this information are satisfactory.

COMPARISON WITH RECORDS OF THE LIVERPOOL PORT LABOUR OFFICER

The survey in Bootle was carried out as part of an investigation of the effect of the air raids of June, 1940 on the working of the Port of Liverpool and data obtained from the Port Labour Officer make it possible to check the accuracy of the survey method. Before the data are examined, however, a brief description of the organisation of dock labour is necessary.

Until March, 1941 dock labourers were registered under the Liverpool Dock Scheme of the Ministry of Labour and National Service, and employed directly by the Master Porters and by stevedoring firms. Wages were paid by the Ministry on behalf of the firms. There were also considerable numbers of unregistered workers, employed and paid directly by the firms. After March, 1941, however, all dock labourers were registered under the Merseyside Area Port Labour scheme of the Ministry of War Transport, and allocated to employers. The wages were paid by the Ministry of Labour and National Service, and the docker guaranteed a minimum week of 11 turns.

The data provided by the Port Labour Officer give the numbers of dockers working and the surplus at the first call* on each day after the introduction of the Ministry of War Transport scheme is plotted in Fig. 23.

The data showed that there was little permanent loss to the labour force at the Port. The numbers registered weekly fell from 17,500 on March 21st to 16,700 on April 25th, 1941, prior to the raids in May. This fall is believed to be due to the tightening-up consequent on the new registration system. There was a further temporary fall in the weeks of the raids, but by May 13th the number registered had risen again to 16,300 and subsequently remained practically stationary at this figure. The permanent loss of workers therefore appears to be very small, of the order of 2% to 3% of the total labour force. The actual loss may have been greater but masked by the employment of new personnel not previously on the books.

The numbers registered weekly do not give any picture of the labour available on any one day but this is provided by the number of dockers answering the first call. Prior to the raids this was fairly steady at between 13,000 and 15,000, the mean value for the week before the raids being 14,400. The figure again reached stability by the end of May, though the mean values 12,900 during the fortnight June 16-28th were somewhat lower. It is, however, doubtful whether this represents a real loss in labour seeing that the numbers registered weekly remained constant.

If we take the mean of 14,400 and 12,900 i.e. 13,650, to represent the average number that would have answered the first call over the period had there been no raids, we obtain the following results:-

---

* First call was at 7.45 a.m. Day shift lasted from 8 a.m. to 7 p.m., including 2 hours overtime. Second call was at 12.45 p.m., when night shift was also detailed. Night shift started at 8 p.m.

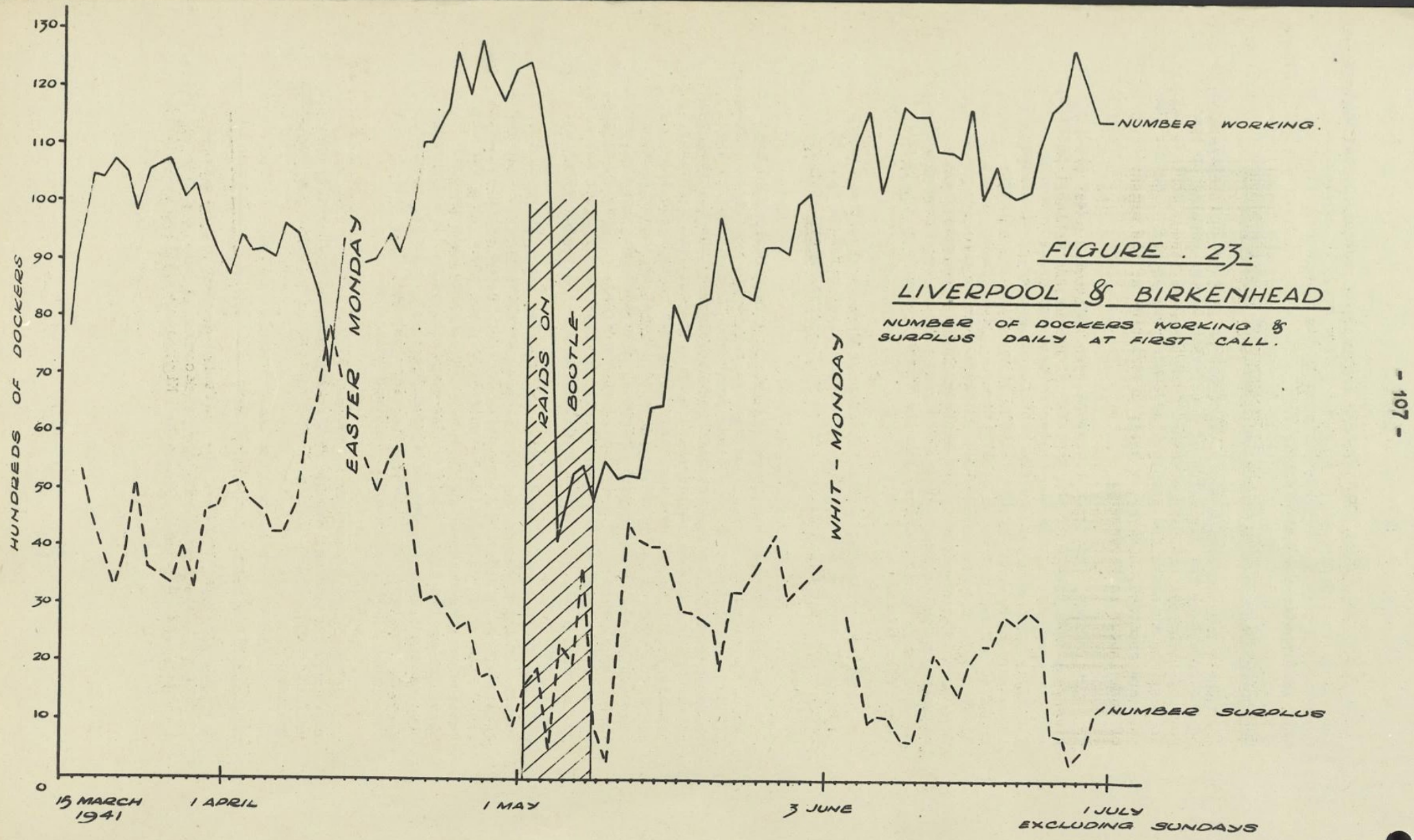


FIGURE . 23.

LIVERPOOL & BIRKENHEAD

NUMBER OF DOCKERS WORKING & SURPLUS DAILY AT FIRST CALL.

Anticipated attendance - May 1st-June 30th, 1941 ..... 696,000 man-days
(13,650 x 51)

Actual attendance - May 1st-June 30th, 1941 ..... 592,000 man-days

Loss of time ..... 104,000 man-days

Days lost ..... 7.6 days per man

The survey in Bootle covered all workers resident in the borough, but the sample includes 64 dock labourers of whom 66% lost time from work. The mean time lost per worker was 8[*] days. This figure compares very satisfactorily with the 7.6 days obtained from the Port Labour Officer's records. Such close agreement must of course be regarded as partly fortuitous, but it does suggest that the methods used are capable of giving reasonably accurate results.

In spite of this absenteeism Fig. 23 shows that a surplus of labour was always available. The numbers reporting for work were greatly reduced during the May raids, but so too was the demand for labour, and even after the heaviest raids all workers reporting for the first call were not employed. At times the position was not known at some of the control points at which workers were reporting, and others were short by small numbers of dockers. Under the Government scheme in operation in May it became possible to transfer workers from dock to dock though in some cases there were transport difficulties.

COMPARISON WITH THE RECORDS OF THE SINGER MANUFACTURING COMPANY, CLYDEBANK

Detailed records were provided by the Singer firm, and Table 49 compares these with the findings of the survey. The latter indicates that the total time lost by Singer workers because of evacuation, injury, or other personal reasons (but excluding time lost because no work was available) was about 42,000 worker-days, equivalent to about 1 week's absence of the entire staff. In addition the survey indicates that about 4% of the Singer workers living in Clydebank were killed, departed permanently from the area, or retired from active work, necessitating an added loss of about 4,000 worker-days in the finding and training of replacements. As shown in the Table these estimates totalling 50,000 worker-days lost, plus 15,000 days estimated from survey data as having been lost by Singer workers because of "no work available", check very closely with Singer's figures of total worker absences. Altogether it appears that these worker absences and the disorganisation that they would have caused would have resulted in a loss of about 1½ weeks production for the entire plant even if there had been no physical damage to the Singer plant itself.

---

[*] This figure is probably taken from Table 5 of R.E.N. 241, which deals with a total sample of 657 workers in Bootle, as compared with 681 workers given in Table 18 and 686 in Table 51. While the difference in the latter two totals is explained in Table 51 the basis for the first is not clear although the basic sample is the same in each case. Using the breakdown of dock workers given in R.E.N. 241 the days lost per worker in the docks should be 6.1 and not the 5.04 given in Table 51. The degree of reliability therefore of the 8 days given above is not certain.

TABLE 49

Singer's, Clydebank - Comparison of absenteeism as given by Clydebank survey and Singer's wages records

CLYDEBANK SURVEY			
Reason given for loss of time	No. of workers	No. of days lost per worker	Man-days lost
Personal	3,500	12	42,000
Work not available	7,300	2	15,000
Finding and training replacements for those permanently left	150	25	4,000
Total loss of time			61,000

SINGER'S WAGE RECORDS	
Man-hours per week (average for 4 weeks ended 8th March)	362,000 man-hours
Total deficiency after this date (14th March - 31st May inclusive)	527,000 man-hours
Equivalent deficiency in man-days (1 man-day = 8.2 man-hours)	64,000 man-days

APPENDIX VI

METHOD OF FITTING STRAIGHT LINES AND CURVES TO THE DATA

In determining the best linear fit, the question of weighting must be taken into consideration. It is clear that the absolute variability of the losses with heavy raids is likely to be greater than with small raids, but their relative variability is likely to be less. The observed values of y have therefore been weighted proportionally to $1/x$ (where for any figure the values of the abscissa are denoted by x and values of the ordinate by y).

When fitting a straight line restricted to pass through the origin, as must be the case here, this is equivalent to calculating the slope of the line from the ratio of the sum of all the values of y, to the sum of the corresponding values of x, i.e.

$$b = S(y)/S(x).$$

This value of b is in fact a weighted mean of the values of y/x for the separate towns, with weights proportional to x. The standard error of b can be calculated in the ordinary manner appropriate to weighted observations, and from this standard error limits of error corresponding to any given probability level can be assigned.* A probability level of 1 in 20 is used here. Thus the loss of time from all causes per 1% of all buildings destroyed is shown as 0.37 days per worker with limits of error of 0.28 and 0.46. This implies that if the true value is 0.37, the chance of obtaining a value of 0.28 or less, or of 0.46 or more, is only 1 in 20.

The fitting of the curves in Figs. 9 and 12 proceeds in a similar manner. Curves of the form $y = 17(1 - 10^{-kx})$ were chosen, these being asymptotic to $y = 17$ and passing through the origin. The same weights were used as in fitting the straight lines, the actual fitting being performed by successive approximation.

---

* If estimated standard error of b is s then limits of error are $b \pm st$ where t is "Student's" t for given probability level and degrees of freedom on which the error is based (see Fisher and Yates, "Statistical Tables for Biological, Agricultural and Medical Research", Oliver and Boyd).

APPENDIX VII

THE AGE COMPOSITION OF THE POPULATION OF THE SURVEY TOWNS

Total Persons	Age Composition (%)										
	Clyde-bank	Bootle	Canter-bury	Ply-mouth	Exeter	Norwich II	Greenock	Coventry	Birming-ham	York	Grimsby
0-14	21	20	16	22	19	18	27	17	20	19	24
14-19	7	8	7	7	7	8	10	8	6	8	9
19-40	60	62	58	26	60	61	27	35	32	64	25
40-60				30			26	28	28		26
Over 60	12	10	19	15	14	13	10	12	14	9	16

APPENDIX VIII

THE PERCENTAGE OF FEMALES IN THE SURVEY TOWNS

Sample	Percentage of Females										
	Clyde-bank	Bootle	Canter-bury	Ply-mouth	Exeter	Norwich II	Greenock	Coventry	Birming-ham	York	Grimsby
Total Persons	1958	1630	734	2216	1216	1374	2084	2002	4270	1174	1500
No. of Females	1032	929	460	1240	717	798	1128	1023	2349	659	853
% of Females	53	57	63	56	59	58	54	51	55	56	57

APPENDIX IX

TABLES 50 - 60

Loss of working time for all causes in different industries (during 3 weeks - 17 working days - following the raids)

TABLE 50

CLYDEBANK

Industrial Group	Raid of March, 1941		
	No. of workers in sample*	% Female	Days lost per worker
Ship repair (John Brown)	238	5	6.96
Ship repair (other firms)	79	6	7.38
War industry (Singers)	179	40	8.09
War industry (other firms)	153	21	7.91
Transport	19	16	4.59
Distributive trades	129	60	9.67
Miscellaneous	100	47	4.92
Total or mean	Total 897	Mean 28	Mean 7.50

TABLE 51

BOOTLE

Industrial Group	Raid of May, 1941		
	No. of workers in sample*	% Female	Days lost per worker
Ship-building	43	0	5.47
Docks	121	2	5.04
War industry	105	58	3.83
Other industry	114	55	7.21
Transport	15	25	5.73
Distributive trades	117	52	4.02
Government service	86	20	2.31
Miscellaneous	85	55	5.72
Total or mean	Total 686	Mean 37	Mean 4.83

* This figure includes persons who were absent from work at the time of the raids and persons for whom the time lost from work after the raids is unknown who are excluded from Table 18.

TABLE 52

CANTERBURY

Industrial Group	Raid of June, 1942		
	No. of workers in sample	% Female	Days lost per worker
War industry	9	22	1.4
Other large industry	19	32	1.4
Transport	14	29	1.1
Government service	63	38	1.3
Distributive trades	120	47	2.3
Miscellaneous	67	67	3.8
Total or Mean	Total 292	Mean 47	Mean 2.3

TABLE 53

PLYMOUTH

Industrial Group	Date of Raid				
	March, 1941			April, 1941	
	*No. of workers in sample	% Female	Days lost per worker	*No. of workers in sample	Days lost per worker
Docks	212	6	0.82	196	2.03
Other war industry	55	15	0.69	53	1.50
Other industry	29	45	2.15	26	1.82
Transport	43	12	0.93	37	0.33
Distributive trades	226	50	2.18	202	2.73
Government service	137	30	0.58	126	0.72
Miscellaneous	60	63	1.17	56	1.83
Total or Mean **	Total 762	Mean 30	Mean 1.26	Total 696	Mean 1.83

* This figure includes persons who were absent from work at the time of the raids and persons for whom loss of time from work after raids is unknown who are excluded from Table 18.

** Excluding members of forces billeted in the town.

TABLE 54

EXETER

Industrial Group	Raid of April, 1942		
	No. of workers in sample	% Female	Days lost per worker
War industry	55	29	3.6
Other large industry	15	60	3.2
Transport	50	20	0.3
Government service	88	35	1.6
Distributive trades	136	40	4.3
Miscellaneous	119	45	4.3
Total or Mean	Total 463	Mean 38	Mean 3.2

TABLE 55

NORWICH

Industrial Group	Raid of April, 1942		
	No. of workers in sample	% Female	Days lost per worker
War industry	57	25	2.2
Other large industry	125	43	4.1
Transport	30	10	0.1
Government service	60	33	0.3
Distributive trades	135	52	2.1
Miscellaneous	132	45	1.8
Total or Mean	Total 539	Mean 41	Mean 2.3

TABLE 56

GREENOCK

Industrial Group	Raid of May, 1941		
	No. of workers in sample	% Female	Days lost per worker
Shipbuilding and repairs (Scotts)	134	4	4.80
Shipbuilding and repairs (other firms)	92	8	6.17
War industry (Royal Naval Torpedo Factory)	63	10	4.42
War industry (other firms)	205	34	5.05
Transport	56	5	2.36
Distributive trades	170	51	3.78
Miscellaneous	135	54	2.90
Total or Mean	Total 855	Mean 29	Mean 4.32

TABLE 57

COVENTRY

Industrial Group	Dates of Raids				
	November, 1940			April, 1941	
	No. of workers in sample	% Female	Days lost per worker	No. of workers in sample	Days lost per worker
Engineering	641	23	4.63	576	1.67
Other war industry	113	26	4.56	100	1.12
Other industry	14	43	5.19	12	4.79
Transport	13	8	0.58	14	0.29
Distributive trades	161	50	5.58	137	1.52
Government service	81	30	0.58	83	0.86
Miscellaneous	28	50	3.58	21	1.76
Total or Mean	Total 1051	Mean 37	Mean 4.37	Total 943	Mean 1.54

TABLE 58

BIRMINGHAM

Industrial Group	Date of Raid						
	November, 1940			December, 1940		April, 1941	
	No. of workers in sample*	% female	Days lost per worker	No. of workers in sample*	Days lost per worker	No. of workers in sample*	Days lost per worker
Lucas	64	45	1.71	62	0.10	63	0.07
B.S.A.	62	21	4.43	57	0.10	54	0.77
Austin	53	17	Nil	51	0.35	54	Nil
Morris	69	23	1.88	72	0.01	70	0.31
I.C.I.	41	39	1.22	41	0.02	41	0.07
G.E.C.	39	10	0.89	39	0.08	40	0.55
Rover	29	10	1.52	30	0.02	29	Nil
Foundries	62	34	2.11	59	0.30	60	0.51
Allied engineering industry	589	30	1.56	577	0.21	575	0.63
Other industry	184	44	1.15	182	0.42	181	0.29
Unclassified industry	97	34	1.20	94	0.21	91	0.48
Transport	94	16	0.66	96	0.52	95	1.06
Distributive trades	426	45	1.46	410	0.30	401	0.24
Government service	168	41	1.12	162	0.29	159	0.29
Miscellaneous	98	62	1.11	96	0.02	94	0.29
Total or Mean	Total 2075	Mean 36	Mean 1.45	Total 2028	Mean 0.29	Total 2007	Mean 0.43

* This figure includes persons who were absent from work at the time of the raids and persons for whom loss of time from work after raids is unknown who are excluded from Table 18.

TABLE 59

YORK

Industrial Group	Raid of April, 1942		
	No. of workers in sample	% Female	Days lost per worker
War industry	87	16	0.4
Other large industry	79	59	0.7
Transport	94	18	0.8
Government service	62	32	0.4
Distributive trades	99	51	0.6
Miscellaneous	86	38	0.7
Total or Mean	Total 507	Mean 35	Mean 0.6

TABLE 60

GRIMSBY

Industrial Group	Date of Raid				
	June, 1943			July, 1943	
	No. of workers in sample*	% female	Days lost per worker	No. of workers in sample*	Days lost per worker
Fish trade	62	16	0.63	60	0.57
War industry	90	14	0.12	87	0.49
Other industry	67	46	0.57	66	0.49
Transport	67	12	0.54	66	0.75
Distributive trades	157	47	0.33	155	0.70
Government service	82	37	0.28	81	0.13
Miscellaneous	42	52	0.40	42	0.78
Total or Mean	Total 567	Mean 33	Mean 0.38	Total 557	Mean 0.55

* This figure included persons who were absent from work at the time of the raids and persons for whom loss of time from work after raids is unknown who are excluded from Table 18.

APPENDIX X

MOVEMENTS OF LABOUR AND CHANGES OF EMPLOYMENT DURING THE WAR

1. Introduction

In certain towns the survey provided an analysis of the labour force available at different periods during the war, and in the case of Plymouth there is a considerable body of information on the frequency of and reasons for changes of employment. In the bombed towns there have been considerable movements of workers from one employer to another, involving in some cases changes of occupation and industry. Numbers of workers, particularly in the distributive trades, gave up work after their businesses had been destroyed, while others left the area. Although in certain respects the data are incomplete they give information on movements of labour and changes of employment which cannot be obtained from central sources.

2. Movements of labour

The size of labour force in the survey towns during the war was affected by factors some of which tended to increase it while others tended to reduce it.

Factors tending to increase the labour force

(1) Increased recruitment of former non-workers. In peace time the labour force is constantly supplemented as adolescents begin to work. In wartime non-workers in other age groups (particularly women) also become workers and numbers of persons previously retired return to work.

(2) Reduction of the number of unemployed workers.

(3) Importation of labour from outside the towns. This varies in different towns, depending on the priority of the local industry. In some cities there is also an influx of workers, frequently those in Government Service transferred from other cities more liable to attack. Some towns, as Greenock, received an increased number of Service personnel.

Factors tending to decrease the labour force

(1) Call-up of workers to the Forces. The proportion called up is related to the priority of local industry.

(2) Workers leaving the town. Workers may leave the town because of the threat or the effect of raids. In addition to this voluntary evacuation there is sometimes official transfer of labour to places outside the administrative area.

(3) Loss of workers who are killed or injured in raids and also of a certain number who stop work after the raids, but do not evacuate.

These factors have been considered in the survey. The data do not cover the labour force available before the war, which had been changed considerably by the time of the raids. Comparisons can therefore be made only with the position at intervals during the war.

(A) Data obtained in Coventry, Birmingham and Plymouth

In these three towns the data cover those workers who were in the towns at the time of the principal raids, and show the gains and losses of workers from then until the time of the survey. In

each case this period lasts over two years. The method used differed slightly for the three towns. In Coventry and Plymouth the survey covered those workers residing in the houses in the sample at the time of the raids, and also at the time of the survey. Additions to the labour force from outside the town were studied as new arrivals in the original house. In Birmingham, the survey covered only those workers residing in the houses in the sample at the time of the raids. Workers who moved to another house in the town were traced to their new home and were included in the sample, while those workers who had moved into the original house from elsewhere in the town were excluded. Additions to the labour force from outside the town were again studied as new arrivals in the original house.

Table 61 gives the results of this investigation. Birmingham and Plymouth lost about 8,800 and 5,800 workers respectively, while Coventry gained about 1,500.

TABLE 61

Changes in the labour force in Birmingham, Coventry and Plymouth between the time of the raids and the time of the survey

Town (sampling fraction)			Birmingham (1/258)		Coventry (1/92)		Plymouth (1/73)	
Workers			No. in sample	Estimated No.	No. in sample	Estimated No.	No. in sample	Estimated No.
Total workers (November 1940)			2,100	540,800	1,077	99,200	839*	61,100*
No. of workers lost from sample	Called up		162	41,700	53	4,900	58	4,200
	Evacuated		71	18,300	122	11,200	153	11,200
	Died or killed		31	8,000	8	700	18	1,300
	Moved elsewhere in town		Not recorded		233	21,400	165	12,000
	Retired because of	Old Age	15	3,900	6	600	6	400
		Children	35	9,000	17	1,600	17	1,200
		Other reasons	46	11,800	3	300	5	400
	Total workers lost		360	92,700	442	40,700	422	30,700
No. of workers added to sample	New workers	Adult	150	38,600	103	9,500	39	2,800
		Juvenile	96	24,700	62	5,700	46	3,400
	Workers from outside		80	20,600	91	8,400	39	2,800
	Workers from elsewhere in town		Not recorded		202	18,600	218	15,900
	Total workers gained		326	83,900	458	42,200	342	24,900
Total workers			June 1943 2,066	532,000	April 1943 1,093	100,700	July 1943 759	55,300
Net no. gained or lost			-34	-8,800	+16	+1,500	-80	-5,800

* March 1941.

(B) Distribution of Plymouth workers employed in the distributive trades at the time of the raids

The air raids of March, 1941 destroyed a considerable part of the Plymouth city centre, and therefore particularly affected the distributive trades. Many shops were destroyed, and it is of interest to know what happened to those workers who at the time of the raids were employed in this industry. The results are shown in Table 62. Of the 224 workers included in the sample, 54% were still engaged in the distributive trades at the time of the survey, 15% had found their way into other work in the town, 15% had been called into the forces, while 16% had been lost to the labour force because of death, evacuation or retirement from work.

TABLE 62

Plymouth - Distribution of 224 workers employed in the distributive trades at the time of the raid of March, 1941

Employed in	March, 1941		June, 1943	
	No.	%	No.	%
Distributive trades	224	100	121	54
Dockyard			9	
War industry			6	
Other industry			3	
Transport			2	15
Government Service			12	
Miscellaneous			1	
Armed Forces			34	15
Dead			4	
Evacuated			18	
Retired (i.e. ceased work)			12	16
Unknown			2	
Total	224	100	224	100

3. Changes of employment

(1) In Plymouth

Plymouth was the only town in which an attempt was made to discover all changes of occupation, industry and employer which had been made during the war by those workers residing in the town at the time of the survey. For this purpose workers were not considered to have changed their occupation unless they changed from one to another of the groups shown in parts A and B of Table 2. So, for example, an unskilled labourer in the dockyard who became an unskilled labourer in war industry was considered to change his industry and employer, but not his occupation, even though the actual work done in the two cases was different. The composition of the labour force at the time of the survey is given in Table 63.

TABLE 63

Plymouth - Composition of labour force at time of survey (July 1943)

Composition of Labour Force		No. in sample	%
Unemployed		6	1
Members of the forces returned to civilian life		7	1
Forces		57	8
Workers resident outside Plymouth before the war		49	6
Persons who were non-workers before the war	No subsequent change of employment	139	18
	Change of employment	7	1
Other workers	No change of employment during the war	370	49
	Change of employment	97	13
Unknown		23	3
Total		755	100

Of the 104 workers, excluding the unemployed and those who joined or returned from the Forces, who made some change of employment up to July, 1943, all changed their employer, 72 changed their industry and 47 changed their occupation. Of these 104 workers 91 changed their occupation once, 12 twice and only 1 more than twice. Changes of employment were made by 12% of male workers as compared with 16% of female workers.

Finally the reasons for these changes of employment have been analysed as far as they were stated and the results are given in Table 64 below. These figures should be accepted with caution as it is by no means certain that the true reasons were always given by the workers or even in some cases known to them. For instance it is only true in a limited sense to say that 25% of changes of employment were made from personal preference. Some of these workers stated that they had changed to better-paid jobs, but undoubtedly others who considered that they moved voluntarily did so because had they not, they would eventually have been directed to other work.

TABLE 64

Plymouth - Reasons given for changes of employment

	Directed by the Ministry of Labour	Work terminated because of				Personal preference	Health	Unknown	Total
		Raids	War (other than raids)	Other	Total				
No.	17	16	8	9	33	30	5	33	118
%	15	14	7	7	28	25	4	28	100

(2) In six survey towns

Information was obtained on the pre-war employment of workers living in these towns at the time of the raids. Except in the case of Plymouth, for which details have already been given, the enquiry ascertained only whether the work differed at the two periods, and did not take account of the frequency of changes. Table 65 shows the pre-war employment of the labour force available at the time of the raids. In Grimsby 28% of the workers had been non-workers or unemployed before the war. This is because the interval covered is more than 2 years longer than in any other surveyed town, and because the local industry is not such as would lead to the reservation of many workers from the Services. Of workers in Grimsby 24% changed their status, compared with between 7% and 16% in the other towns.

TABLE 65

Pre-war employment of labour force available at time of raids (members of forces excluded)

	Birmingham November 1940	Clydebank March 1941	Coventry November 1940	Greenock May 1941	Grimsby June 1943	Plymouth March 1941
	%	%	%	%	%	%
No. of workers in sample	2087	897	1075	841	570	767
Non-workers and unemployed	6	6	8	10	28	9
Living outside the town	2	2	6	2	2	2
Engaged in different work	11	10	16	11	24	7
In same employment	79	80	66	75	44	77
Unknown	2	2	4	2	2	5
Total %	100	100	100	100	100	100

Table 66 gives the proportion of workers in the six towns who had changed occupation, industry or employer, and here again the figures for Grimsby are markedly greater than those in the other towns. Table 67 shows the proportions of the changes made voluntarily and at the direction of the Ministry of Labour, both for workers and for persons not working before the war. Some changes are no doubt shown as voluntary where failure to change or begin work would have been followed by direction. Even so it is interesting to note that during the war when labour was closely supervised only a small percentage of workers state that they were forced to take their jobs. Most said that they were free to choose their work, and this is undoubtedly true in the sense that workers in peace-time can decide freely to take a job, when they cannot afford not to do so.

TABLE 66

Changes of occupation, industry or employer in 6 survey towns
(Percentages are of the total number of workers in the town)

Towns	Birmingham	Clydebank	Coventry	Greenock	Grimsby	Plymouth
Comparison between	Pre-war and November 1940 %	Pre-war and March 1941 %	Pre-war and November 1940 %	Pre-war and May 1941 %	Pre-war and June 1943 %	Pre-war and March 1941 %
Change of occupation	4.6	4.6	5.7	5.0	10.5	4.7
Change of industry	7.6	7.1	11.4	7.9	26.2	6.2
Change of employer	12.4	10.5	19.0	11.7	35.4	8.2
No. of workers in sample	1875	821	877	802	381	645

This Table excludes workers at the time of the survey who were non-workers or unemployed before the war, persons moving into the town after the war began, members of the Forces, unemployed and those about whom there is no information.

TABLE 67

Reasons given for change from pre-war to pre-raid work
(Percentages are of all workers changing employment)

Reason for change	Clydebank		Coventry		Greenock		Grimsby		Plymouth	
	Workers %	Non-workers %	Workers %	Non-workers %	Workers %	Non-workers %	Workers %	Non-workers %	Workers %	Non-workers %
Directed	6	4	8	1	7	3	20	4	17	3
Voluntary	88	94	87	96	93	96	80	96	38	90
No information	6	2	5	3	-	1	-	-	45	7
No. of workers in sample	86	52	167	79	94	74	135	148	53	68

The workers excluded from Table 66 are also excluded here, except persons not working before the war and those about whom there is no information. No information is available for Birmingham.

APPENDIX XI

A REPORT OF A VISIT TO A PIGGERY WHERE TREKKERS WERE SLEEPING*

"I decided entirely on my own to visit and sleep in the Piggery at Bilton. So I disguised myself with coat and cap, coloured glasses and scarf, items I never wear, unobtrusively parked my car about a mile from Bilton and then joined the trekking throng.

"After walking up to what is more or less the centre of the village near the Church and talking to many folk and asking about billets and if I could get a blanket, I eventually was directed to the Piggery by a man and two women who were most considerate in showing me and guiding me there. I am satisfied that I have now the identity of these three people.

"I eventually found room in one of the pig sties in the Piggery and apologised to the families who were in this sty for disturbing them and asked if they minded me joining them. Then with my respirator as my pillow and my light rug, I lay down on the straw. In this up to date piggery each sty or pen had its own lavatory accommodation at the back - for the pigs - which was constantly used as I was to find out later by both sexes during the night.

"I determined to lay awake all night because I wanted to know how orderly the people were, and everything about them. The Piggery had glass sky-lights which were not blacked out and the people were sleeping under the sky-lights all the way along so no matches or lights could be lit and not one match was struck during the night. There was the usual snoring and hard breathing, with the accompaniment of children's talk in their sleep, and the crying out of the babies in the night and the constant sucking of the feeding bottle and all the other noises that are common to humanity when it is in mass.

"After about an hour or so the warning blew; 6 or 8 men got up quietly, who were evidently acting as wardens and fire-watchers, and went outside. No-one else moved, everyone remained quiet, many of them not waking - snoring and hard breathing still went on. Quiet talk went on about it being better there than in Hull; how pleased they were even to be in a pig-sty so as to get some rest. It was not the bombs they were afraid of, they said, although they did not like them, no-one does, it was just that they wanted bodily rest and sleep.

"An hour or so later the "All Clear" went; those who were awake gave a sigh of relief, rustles amongst the straw, the wardens and fire-watchers came in; they snuggled into the straw and went off to sleep again.

"After about half an hour when everything had been very quiet the rats started. I seemed to have chosen the place which was a traffic road for the rats. Probably that was why no one else was sleeping there. They ran over me, they ran under me but seeing that there were children in the same pig-sty as myself, I kept very quiet for fear anything I did would waken the children and they would become scared. Slowly I heard rustling of straw in other pig sties and a man would say to a woman very quietly "There's rats". Gradually the talk of rats became more audible until the inhabitants of one pig-sty talked to the inhabitants of another. One man said there were a couple who'd been doing a dance on him. Someone from another pen said "There has been one running across me with clogs on". From another pen a woman's voice said "Well, never mind, I would sooner have British rats than Hitler's bombs". After about an hour and a half the rats seemed to have quietened down. On with the sleep and then in the

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* Taken from a report on trekking made by Robert G. Tarran, Sheriff and Chief Warden of Kingston-upon-Hull, 26th July, 1941.

early hours of the grey dawn 3 or 4 got up at 4.15, off they went. 4.30, 10 to 15 more went. By 4.45 all the pig sties were awake and talking. By 5.0 a.m. half the people were beginning to get about so I decided as dawn was breaking that that was the best time for me to be on the move.

"I had talked to the inhabitants of my sty for a little while. Very nice people out of Severn Street, Holderness Road. I wrapped my rug up, adjusted my cap, my scarf and dark glasses, and joined the trekkers back again to Hull.

"First I joined a man and woman of 72 and 73, walking back four miles to their home. Then I helped to carry children here and children there. There was a father and mother with four children walking and three much younger, down to a baby in a pram. No buses, nothing to give them a lift of any description, all moaning because there was no refreshment, no warm drink, no opportunity of fresh milk for their babies, but there was not a scrap of demoralised feeling. They were fighting fit, pleased to have had a night's rest, the men folk especially, and the mothers. It did seem pitiable that the Ministry of Health of this country should allow the young children to be doing these miles there each night and morning, with only a few hours' sleep, which while it is all that grown up people need, it is only half what children need.

"I then fell out by the wayside, at an opportune moment, slipped into a hedge, took off my disguise, discreetly went to my car and after driving past those whom I'd been talking to - I dare not give them a lift because I thought they might recognise my voice - I picked up a load of others and gave them a lift into the city. How I wished I could have given the two old people a lift or that family of man, woman and children."

APPENDIX XII

SUMMARY OF THE PSYCHIATRIC EFFECTS OF SEVERE PERSONAL EXPERIENCES DURING AIR ATTACK

Dr. Russell Fraser

A report has been given elsewhere* of the psychiatric effects of severe personal experiences during the air attacks on Hull. Here the subject will be summarised only. A group of cases, admitted to First Aid Posts in Hull during a period of heavy air attack, was followed up ten months later; 127 cases (76% of the original sample) were visited; a severe personal experience had been the main reason for admission in 55%, and had preceded the admission in 75% of the cases.

(1) Of the 35 who had been buried for over one hour, 66% developed neurotic symptoms, and 40% neurosis causing absence from work; in about equal proportions the neurosis was either temporary or persistent (i.e. persisting at the interview 10 months later).

(2) The type of neurosis among those who had suffered personal involvement was predominantly mixed depression and anxiety (56%) or either of these alone; a further 16% were cases of anxiety hysteria. 27% had trekked (18% regularly for more than 2 weeks), and 32% evacuated for a period following the experience, while 55% neither evacuated nor moved permanently to a safer area of the city. During the raid ten months later 51% were abnormally anxious, and 59% had become more nervous during the raids.

(3) The causes of neurosis development or persistence were studied on the whole group (94) of those who had suffered personal involvement.

(4) It appears that neurosis is likely to follow severe personal air-raid experiences, which at the time upset the individual emotionally, or produced a serious upset in the pattern of his living by destroying a much-esteemed home or a close friend, especially, but not only, if he is of unstable personality and was at the time living under some other strain.

(5) Neurosis, after such experiences, is likely to become persistent when the personality is unstable, or living conditions have become an abnormal strain, either due to general difficulties or to residence in the danger area despite the absence of confidence. Recovery tends to occur when such factors are eliminated and the earliest possible resumption of full normal activities is facilitated and encouraged. Studies on four other groups of persons in Hull give interesting information on the nature of trekking. The groups are:

(i) Dock workers.
(ii) Housewives in a heavily-bombed district.
(iii) Housewives in a lightly-bombed district.
(iv) Persistent trekkers.

The investigation was conducted some months after the raids, and relates only to those persons who had not evacuated.

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* Proceedings of the Royal Society of Medicine, January 1943, Vol. XXXVI, No. 3, pp. 119-123 (Section of Psychiatry, pp. 1-5). Fraser, Leslie and Phelps.
The summary given here corresponds almost word for word with that given by Dr. Fraser at the end of his paper. He has added the notes on trekking that follow. No details are available.

Trekking immediately after the heavy raids

It was observed that the trekkers came from those areas most heavily bombed, and gave as their reason a lack of confidence in the safety of their home area. Investigation showed that these were persons of average stability, some of whom had been made nervous by the raids. Other factors (children or nervous persons at home, damage to the house) had little influence on the frequency of trekking from the heavily bombed area.

Persistent trekking

A study was made of persons still trekking some months after heavy raiding had ceased. These trekkers also stated that they trekked because of need for greater safety. Investigation showed that the group consisted mainly of persons abnormally nervous in raids. 47% were judged to have unstable personalities; 10% had chronic physical illness and 18% low intelligence.

Recovery

It was judged that trekking had been an important factor in the recovery of 27% of those persons in the sample living in the heavily-bombed areas who developed neuroses. The corresponding figure for persistent trekkers who recovered was 68%.

Conclusions

1. Trekking is an expression of lack of confidence in the home area.

2. Trekkers at the height of raiding are persons of average stability but those who persist in trekking for months after heavy raiding has ceased are mainly persons of abnormal personality and to a lesser degree with chronic illness or low intelligence.

3. Trekking was frequently an important factor in the recovery from neuroses due to raids.

APPENDIX XIII

THE ASSESSMENT OF MORALE FROM THE LOCAL PRESS

1. Introduction

An important single source of information for estimating enemy morale was the local foreign press, but the reliability of such estimates was most difficult to determine. Clearly if the estimates were dependable they would indicate those towns with low morale where a greater than average effect on labour could be anticipated from raids, and they would also give one measure of their effect. Post-raid absenteeism for personal reasons has in this report been taken as the most useful measure of morale, and one which could be quantitatively related to various indices of the weight of attack. It seemed worthwhile, therefore, to examine local newspapers in the British towns studied, and to compare the state of morale revealed by press comments with that indicated by absenteeism.

2. Method

Local daily newspapers published in each of seven towns were examined for approximately three weeks before raids; weekly newspapers were studied for five to six weeks before raids, and both dailies and weeklies for eight to sixteen weeks after raids. Accounts of the lighter raids and matter relating to them became negligible in amount after about eight weeks, but following the heavier raids the newspapers devoted space to raid topics for sixteen weeks or even longer.

An impression of the pre-raid morale of each town was sought from a general reading of the newspapers published in the town, but in general the reading covering this period gave little guide to the behaviour of the citizens after being raided.

The newspapers published after raids, both in the town and in the neighbourhood were studied in closer detail. The amount of space devoted to each topic was noted and a summary, with quotations at length where it seemed necessary, was made of the contents of each newspaper article or other mention of matter relating to the raids.

Papers published in the towns concerned, even though in some cases they were printed elsewhere during the immediate post-raid period, were always much richer in information than papers published in adjacent towns. When the adjacent town had not suffered from the raid, the interest of its papers in other than a relatively factual account of what had happened was usually small, and when it had actually suffered itself (e.g., Liverpool and Glasgow newspapers referring to raids on Bootle and Clydebank respectively) the papers were more concerned with the town's own problems than those of their neighbours. Only one newspaper was silent about a raid on its own city, and in general the papers published within a raided town gave much greater detail than those published outside.

Table 68 gives the amount of space devoted week by week by five Kent newspapers to the Canterbury raids. Much more space was given to raid topics by the papers published in Canterbury itself. However, the space devoted to particular topics, or even the total space devoted to all the raid topics as a percentage of available news space was found to be a poor guide to the intensity or nature of the raid, or to the reactions to it. This is illustrated in Table 69, which shows the percentages of newspaper news columns devoted to raid topics during the two weeks after the raid in each of the towns studied. Neither the percentage of buildings destroyed in the town nor the intensity of the town's reaction to the raids, however measured, is constant in its relation to this space allocation.

Further analysis has therefore been based on the frequency of mention of topics associated with the raids and on the mention or lack of mention of related topics. The analysis had to be conducted with partially-summarised material and for each paper and each town the most frequently mentioned topics were discovered by an approximate count of their appearances in the press. The following analysis has been founded on pooled information for all papers in each region concerned, but it should be borne in mind that perhaps 80 or 90% of this information was found in papers published in the raided towns. The papers include all those published in the town by independent publishers; where two or more papers were issued by a single publishing house, not all of these have been separately analysed in detail, since their content was found to be similar or even identical. This similarity of content sometimes extends over a group of papers published in a locality, Norwich being an extreme example.

TABLE 68

Canterbury - Percentage of news columns in weekly local newspapers referring to the raids

Week ending	Local papers		County papers			Remarks
	1	2	3	4	5	
June 6th	51	19	12	8	4	Heavy raid was on May 31st.
" 13th	22	40	7	1	0	-
" 20th	7	10	1	0	0	-
" 27th	8	10	2	0	1	-
July 4th	16	22	6	1	2	Censorship ban on details of damage lifted.
" 11th	3	2	2	0	0	-
" 18th	10	16	1	0	1	Ministry of Information Committee discussed raids in town.
" 25th	2	6	2	1	3	-

Key:

1. Kentish Gazette and Canterbury Press
2. Kentish Observer and Canterbury Chronicle
3. Kent Messenger
4. Kentish Express
5. Herne Bay Press

Published in:
Canterbury
"
Maidstone
Ashford
Herne Bay

TABLE 69

Percentage of total space devoted to raid topics in the first two weeks after raids by papers published in the town

Town	% buildings destroyed	Newspaper	% space taken up by raid topics
York	0.7	1)	9.5
		2)	7.5
		3	11.0
		4	0.0
Norwich	4.6	1)	9.0
		2)	11.0
Canterbury	5	1	35.0
		2	34.0
Greenock	7	1	6.5
Exeter	9.8	1)	11.0
		2)	15.5
Bootle	11	1	38
Clydebank	27	1	33.0

Newspapers linked are produced by same publishers.

3. Typical cycle in the local press

The first reports were amplified official communiques, with "local colour" such as personal anecdotes of escapes, etc. added. In a day or so editorials about "Hun frightfulness" and the citizens' courage appeared, with pictures of bomb damage but without naming the buildings or localities concerned.

Then came accounts of the excellent work done by the local Civil Defence services, mobile kitchens, etc. and the satisfactory organisation of evacuation and billeting. Reports of funerals followed and an Air Raid Distress Fund was opened. The Regional Commissioner visited the town and the Mayor's work in civic reorganisation was reported.

After the first week there might be a lull, save perhaps for a Royal visit or a meeting of the Town Council or other emergency committee, but the press might now contain letters critizing local arrangements and there might be reports of imported labour to assist in housing repairs.

After a month more detailed accounts of damage appeared although advertisements from which damage might be located were frequently printed earlier than this. At this point also further comment on and sometimes criticism of local government activities was published although criticism from central sources was on occasion strongly resented.

4. Assessment of morale from the pre-raid local press

Both in 1941 and 1942 papers for all districts reported a serious increase in crime, particularly juvenile crime. These reports were so general that no specific local interest could be attached to them. Press readings of the local papers before each raid gave the following differential indications of the morale of the towns:

York:
1. Less drunkenness than formerly.
2. Fire watching bad, e.g. less than half of those enrolled for duty actually turned up.

Summary: Morale seemed good, but due possibly to a feeling of security, A.R.P. seemed rather slack.

Exeter:
1. "Several thousand of 17,000 Exeter fire guards have completed Part I of their training". This is the only pointer to efficiency observed in the Exeter papers.

Summary: Morale appeared excellent.

Norwich:
1. Although in the surrounding district, Yarmouth in particular, there appeared to be much crime and looting, Norwich itself was relatively free. No points of note were observed as regards other topics.

Summary: Morale appeared excellent.

Canterbury:
1. There seemed to have been bickering about minor A.R.P. matters, but little else of note.

Summary: Morale appeared excellent.

Bootle:
1. Evacuation of children was continually being urged, as only 3,600 had been evacuated and 10,000 remained.
2. School attendance, even at the best schools, was said to be very poor - less than 60%.
3. Marked increase in juvenile crime.

4. Agitation for deep shelters, although the existing ones were being made more comfortable.
5. The A.R.P. services in Bootle were considered to be efficient.

Note: A similar situation was reported of Liverpool in the Liverpool papers.

Summary: The morale of Merseyside would appear to have been somewhat adversely affected by its previous raid experience and the evacuation problem in Bootle was probably acute because Bootle was not an official evacuation area.

Greenock:

1. Particular complaints of drunkenness.
2. Many blackout offences were reported.
3. Doubt was expressed on several occasions as to the adequacy of the First Aid Posts (there were three main and two mobile posts).
4. So few recruits for fire-watching duties that compulsion was being threatened.

Summary: Particularly in view of its relative immunity from previous raids, Greenock did not show up well, although some complaints may have been expressions of a reasonable condemnation of local organisation.

Clydebank:

1. Complaints of lateness and absenteeism in local schools.
2. Complaints that A.R.P. equipment was insufficient. Stirrup pumps, sand bags and ladders were all at various times reported as being too few.
3. The phrase "Why should we watch the factors'* premises?" recurs in the papers and was the attitude of some sections of the population.

Summary: Apart from this general attitude to fire watching, Clydebank appeared rather similar to Bootle, with little indication of any marked superiority to Greenock.

Thus the northern ports appeared to show up less well than the Baedecker towns but there was no indication that Greenock was any worse in this respect than either Clydebank or Bootle although in the event it proved to be so.

In general the pre-raid local press was a poor guide to the morale of a town under air attack and there was insufficient information to justify a detailed analysis such as has been attempted of the post-raid press.

5. Analysis of the post-raid local press

The classes into which press reports were divided for examination are listed in Appendix XIV.

It was thought at first that practically all classes of reports might yield information relevant to morale, while the material in some could also be related to the extent of damage. Experience showed that some classes were virtually useless for this purpose, since the information in them either did not discriminate between the degree of damage or loss of time from work, or was too scanty for use. Such were classes 2, 12, 14, 20, 22, 33, 38, 39, 41, and 42. Thus workers were always drafted into the city, but details were few and not very helpful. Tours by Royalty were made in the more lightly-raided towns, but not in Bootle, Greenock or Clydebank, and the number

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* Rent collectors!

and nature of other important visitors seemed to bear no relation to the degree of damage. Savings and war charities were voluminously reported in most papers, but again no particular relationship appeared. The attitude to the enemy did not change appreciably from one town to another. It might well be, however, that these statements would not be true of towns suffering a greater intensity of raiding than that actually experienced by those considered here.

Few classes of reports yielded quantitative material for all towns, and these were more related to material damage than to anything else. The four main classes are shown in Table 70 in which the percentage of "looters convicted" rises steadily with the percentage of houses and of buildings destroyed but is not so well related to the loss of working time. This suggests that looting is rather a question of opportunity than of anything else. The relatively low figure for Clydebank is doubtless incorrect as the reporting of cases of looting was peculiarly difficult to follow in the Clydebank press, since few of the accused were named, and apparently some convictions were not reported. The other three classes in the Table serve to indicate that the destruction of less than about 5% of buildings is not associated with a cessation of education in the town, whereas it ceased for from one to three weeks in towns with 7 - 11% of buildings destroyed, and completely in Clydebank with 27% of buildings destroyed.

Detailed reports of damage were not published in the Clydebank papers, and the long delay in naming both Clydebank and Greenock appears to be peculiar to Scotland.

Deductions may be drawn from the press about the extent of damage in the town. Much information is usually given about a month after raids as to the numbers of schools, churches and other public buildings hit or damaged and a full statement of these normally emerges. The number of casualties is not usually divulged in the press following the heavier raids and death notices may be spread out over a considerable period, the particular routine followed seeming to depend to some extent on the whim of the local publishers as well as on censorship. Details of casualties to members of the police and Civil Defence services are often given and the number of casualties is frequently said to be heavy or light, as the case may be, in relation to the scale of the attack, although these judgements are often at fault.

Given the total number of the various types of building exposed, it is possible in some cases to prepare an estimate of raid damage from press information. This would be aided by advertisements of the closing and reopening of various shops and business premises, but again, censorship apart, there is considerable discrepancy from one paper to another within the same town. When the telephone services, public utility services and transport are interfered with, mention is frequently made of the fact, and although censorship is imposed in order to limit appreciation of damage in the raided town, it seems doubtful whether this censorship was able, save possibly in the case of Clydebank, to prevent a reasonably good picture of the damage being formed eventually, although this cannot be done within a short time of the raid.

Accounts of the attitude and behaviour of the local population and Civil Defence personnel, or increases in A.R.P. establishment and of post-raid relief, contained much criticism and adverse press comment which tended to increase with increasing weight of attack. These reports have been analysed and are presented in Table 71 which gives the number of cases of adverse reporting for a group of towns over a similar period.

It will be seen from Table 71 that the press of the Baedeker towns and districts did not comment adversely nearly so often as did that of Bootle, Greenock and Clydebank. It is unfortunate that there is an association, on the one hand, of mild press comment with later raiding on the Baedeker towns and, on the other, of more vigorous comment, heavier and earlier raiding on a different type of

TABLE 70

Relation between facts given in the local press of raided towns and the intensity of attack

	York	Norwich	Greenock	Exeter	Canterbury	Bootle	Clydebank
Number of looters reported as convicted, per 1,000 people in the town.	0.01	0.03	0.05	0.22	0.05	0.55	(0.75)
Time in days before any schools reopened.	0	0	13	21+	?	22	>120
Time in days before details of damage were given.	30	30	26	30	30	some at 14	>120
Time in days before town was named.	0	0	26	5	0	0	34
% of buildings destroyed.	0.7	8.7	(7)	9.8	(10)	(11)	(27)
% of houses destroyed	0.7	5.1	5.2	5.8	9.5	8.1	33
Days lost per worker for all reasons.	0.6	2.3	4.3	3.2	2.3	4.8	7.6
Days lost per worker for personal reasons.	0.7	1.1	3.0	0.9	1.3	2.8	6.5

Figures in brackets represent estimates.
Days lost per worker are for the first three weeks in both cases.

TABLE 71

Adverse Press Reports in Seven Towns

Press reports	York	Exeter	Norwich	Canterbury	Bootle	Greenock	Clydebank
Mention of evacuation or trekking.	-	+	+	+	++	++	++
Trouble over evacuation and billeting.	-	-	+	-	+	++	++
Mild adverse comment on post-raid spirit of the people.	-	-	-	+	+	-	+
Criticism of housing repair and/or accommodation in the town.	-	+	-	-	+	++	++
Post-raid increases in A.R.P.	-	-	+	-	+	+	+
Post-raid increases in relief services.	-	-	-	-	+	+	+
Criticism of post-raid relief.	-	+*	-	-	+	++	++
Criticism of local government.	-	-	-	-	+	++	+
Criticism of central government.	-	-	-	-	++	+	+
Criticism of shelters.	-	-	-	-	+	+	++
Criticism of efficiency of A.R.P. services during the raids (other than fire-watching).	-	-	-	-	-	+	+
Total no. of + signs.	0	3	3	2	12	15	16

- No mention + Some mention ++ Frequent and/or strong comment

* This criticism was more national than local, but was reported in the local press.

community in Clydebank, Greenock and Bootle. These considerations make it doubtful how far gradations of press response are independent of differences in time and locality and how far they are dependent on increasing severity of attack and reaction within the towns.

A sidelight on the difference between raids in 1941 as against 1942 is that, although fire-watchers as such were not criticized in the heavier raids of 1941, they were mildly criticized in each Baedeker town, where raids occurred after National Registration for street firewatching had been introduced. However, since the other indications are that, with the exception of Greenock, the northern ports fall into line with the Baedeker towns in the amounts of absenteeism, evacuation and trekking exhibited in relation to the damage they suffered, this segregation into two rather contrasted groups is perhaps of less consequence than might be supposed.

Since the measure of degree of press criticism and weight of attack in the form of the various indices of its effectiveness are rather crude, probably the best way of comparing them is by "ranking" them. The seven towns in Table 71 are taken and placed in increasing order of amount for press comment, for effective density of attack, for casualties and so on. This has been done in Table 72.

TABLE 72

Comparison between number of adverse press reports, indices of attack and time lost from work during the first three weeks for seven towns

Town	York	Canterbury	Exeter	Norwich	Bootle	Greenock	Clydebank
Adverse Press comment	1	2	3	3	5	6	7
Effective density of attack	1	5	4	3	6	2	7
Casualties/ 1000	1	5	4	2	6	3	7
% buildings destroyed	1	5	4	3	6	2	7
% houses destroyed	1	6	4	2	5	3	7
Time lost for all causes	1	3	4	2	6	5	7
Time lost for personal reasons	1	4	2	2	5	6	7

The numbers represent the order of the towns for increasing adverse press comment, casualties, etc.

Thus York shows the least press comment, the least weight of attack and the least loss of time as Clydebank shows the greatest. Norwich and Exeter, again, show equal amounts of adverse press comment but more than Canterbury, which in turn shows more than York.

Three major conclusions may be drawn from the Table. The first is the satisfactory similarity in ranking between effective density, casualties, percentage buildings and percentage houses destroyed, i.e. between the four indices of effectiveness of attack. The second is that time lost for personal reasons shows the nearest similar ranking to that of adverse press comment. The third is that Greenock shows excessive comment and loss of time for personal reasons for its weight of attack just as Canterbury shows the reverse.

The press items in Table 71 have been selected because they include criticism of public organisation and spirit. It is possible that one or two of the classes of material are there by chance or equally that

others that should have been included have been omitted, but on the whole the similarity of type in the material is good evidence that a real relationship exists between excessive loss of time for personal reasons and lack of public confidence.

By the conception of morale advanced in the first section of Chapter 6, the state of mind of the workers is only of significance to the war effort when it involves unnecessary loss of working time. On this view, as also in the comments of the press and of the Ministry of Information at the time, Greenock suffered from low morale. The explanation appears to lie as with the first raids on Coventry and Birmingham, not in any innate inferiority of the people of the town but in the lack of initiative and foresight, amounting at times to obstructionism, shown by the Councils and Emergency Committees concerned.

Conclusions

In attempting to estimate the state of morale of a town from the press the most important factor to take into account would seem to be marked and frequent comment on crime, drunkenness, looting and the behaviour of the people in general. Criticism of A.R.P. shelters, post-raid services and of the local and central authorities is not in itself an indication of bad morale, and may reflect the normal course of events in a town which has been badly hit. It is when the degree of criticism is high relative to the material damage done in the town that it can be regarded as evidence that morale is weak. Press comment alone may give a most misleading picture of the state of morale and should only be read in the light of the damage caused in the town.

APPENDIX XIV

ASSESSMENT OF MORALE FROM THE LOCAL PRESS
Classes into which newspaper material was divided

1. Factual accounts of the raids.
2. Statements about indiscriminate bombing, or of aiming at the homes of the people.
3. Details of damage and casualties.
4. Time of release of details of damage.
5. Accounts of behaviour of population.
6. Accounts of fire watching.
7. Accounts and opinions of A.R.P., F.A.P., W.V.S. services, etc.
8. Attitude of population to shelters.
9. Use of shelters.
10. Post-raid relief, feeding arrangements, rescue work, etc.
11. First aid repair to housing.
12. Drafting of workers into the city.
13. Drafting of military or other fighting services into the city.
14. Letters and messages of sympathy.
15. Evacuation and billeting.
16. Behaviour of evacuees and trekkers.
17. Trekking.
18. Looting.
19. Panic.
20. Crime, drunkenness and immorality.
21. Rumours.
22. Tours of City Councillors, Regional Commissioners, politicians, etc.
23. Town Council meetings.
24. Opinions of population of local and central authorities.
25. Statements by the local authorities on the raid.
26. Statements by the central authorities on the raid.
27. Individual experiences of the inhabitants.
28. Distribution of honours to inhabitants.
29. Advertisements of firms, etc., closing, reopening or transferring premises.
30. Advertisements of businesses, such as those of undertakers and A.R.P. suppliers.
31. Public notices about utilities, transport, etc.
32. Funerals of victims and death notices.
33. Explanations of how to claim for compensation.
34. Rehousing.
35. Closing and reopening of schools.
36. Specific increases in A.R.P.
37. Specific increases in post-raid relief.
38. Discussion of post-war planning.
39. Emergency postal, telephone services, etc.
40. Rate of restoration of public utilities.
41. Savings, war charities, etc.
42. Attitude to the enemy, e.g. "The raid illustrated the desperate straits of the enemy".

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